



OWNER'S MANUAL

OASIS CAR WASH SYSTEMS
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WATER SOFTENER INSTALLATION

The first system that should be hooked-up in the car wash is the water softener and brine tank assembly.

1. Install the unit as close to the incoming water supply as possible. After thoroughly cleaning the area in which water softener is to be positioned at, move the unit and brine tank into place.
2. Plumb the water softener into the system, as recommended by the plumbing blueprint supplied with this manual.
 - A. Connect the incoming water supply to the water softener.
 - B. Supply the outgoing softened water to the water heater.
3. Plug the cord from softener head into the duplex receptacle provided by an electrician.
4. Due to a wide variety of water softeners available, please consult the Owner's Manual provided with the softener to correctly set the clock or water meter.

Water softener installation is now completed.

MULTI-TANK SIZING GUIDE

Pulsing							
Tank	Flow Rate per tank	Working Capacity per tank	Regen. Time min.	Grains per min. regen. one tank	Grains per min. regen. two tanks	Grains per min. regen. three tanks	Grains per min. regen. four tanks
8x35(30)	10	9000	28	321	642	963	1284
8x35(45)	10	11250	35	321	642	963	1284
9x48	15	15750	49	321	642	963	1284
10x54	15	30500	63	482	964	1446	1928
12x48	20	49500	77	642	1284	1926	2568
13x54	25	54000	84	642	1284	1926	2568

Non-Pulsing							
Tank	Flow Rate per tank	Working Capacity per tank	Regen. Time min.	Grains per min. regen. one tank	Grains per min. regen. two tanks	Grains per min. regen. three tanks	Grains per min. regen. four tanks
8x35(30)	10	9,000	18	500	1000	1500	2000
8x35(45)	10	11,250	20	500	1000	1500	2000
9x48	15	15,750	31	500	1000	1500	2000
10x54	15	30,500	40	750	1500	2250	3000
12x48	20	49,500	49	1000	2000	3000	4000
13x54	25	54,000	54	1000	2000	3000	4000

Water Usage Charts

Flow in gallons per minute and pipe size for ordinary plumbing fixtures											
Number of fixtures	1	2	4	8	12	16	24	32	40		
Water Closets											
Tank GPM	8	16	24	48	60	80	96	128	150		
Pipe Supply Size	1/2	3/4	1	1-1/4	1-1/2	1-1/2	2	2	2		
Flushometer GPM	30	50	80	120	140	160	200	250	300		
Urinals											
Tank GPM	6	12	20	32	43	56	72	90	120		
Pipe Supply Size	1/2	3/4	1	1-1/4	1-1/4	1-1/4	1-1/2	2	2		
Flushometer GPM	25	37	45	75	85	100	125	150	175		
Pipe Supply Size	1	1-1/4	1-1/4	1-1/2	1-1/2	2	2	2	2		
Lavatories and Sinks											
Faucet per GPM	4	8	12	24	30	40	48	64	75		
Pipe Size	1/2	1/2	3/4	1	1	1-1/4	1-1/4	1-1/2	1-1/2		
Bath Tubs											
GPM	15	30	40	80	96	112	144	192	240		
Pipe Size	3/4	1	1-1/4	1-1/2	2	2	3	3	3		
Slop Sinks											
Faucet per GPM	15	25	40	64	84	96	120	150	200		
Pipe Size	3/4	1	1-1/4	1-1/2	1-1/2	2	2	2	3		

HOW TO CALCULATE COMPENSATED HARDNESS:

Calculating compensated hardness

Compensated hardness factors

1. Enter hardness here	_____	Result from Step 3	Compensation factor
2. Enter PPM of iron here	+ _____	1 - 20	1.1
		21 - 40	1.2
3. Add lines 1 and 2 and enter results here.	= _____	41 - 70	1.3
		71 - 100	1.4
		100+	1.5
4. Enter the appropriate compensation factor from chart at right here.	x _____	EXAMPLE: 10 Grains + 3 PPM Iron = 13 Total Hard. x 1.1 Comp. Fact. = 14.3 Comp. Hard.	
5. Multiply the sum from line 3 by the compensation on line 4. Enter result here.	= _____		

Continuous Flow: The maximum volume of water/minute the system will handle 24 hrs/day.

Peak Flow: The maximum volume of water the system will handle/minute for short periods of time.

HOW TO READ THE UNIT SIZE:

1. The first two digits identify resin tank diameter.
2. The second two digits identify the number of tanks in the system.
3. The third two digits identify resin tank height.
4. The single digit identifies the number of brine tanks in the system.

* Regenerate two tanks at a time.

*** Regenerate four tanks at a time.

NP No Pulse Program is used to shorten the regeneration time.

12 0 6 48 - 2 * This is a 6 tank 12x48 system with 2 brine tanks. The system will regenerate two tanks at a time.

TANK AND HEATER INSTALLATION

1. After uncrating the heater, clean out the area in which the heater will be positioned in the equipment room.
2. Set the heater about 12" from the wall, insuring good ventilation all around.
3. Most heaters will consist of a boiler, insulated tank, and a circulation pump. Please refer to the Owner's manual provided with the heater for proper hook-up.
4. Instruct the plumber to bring cold, soft water from the softener to the heater, and then pipe hot soft water to the tank.
5. An electrician will need to provide 110V single-phase 20-amp service to the circulation pump.

REVERSE OSMOSIS UNIT INSTALLATION

System Description

The Oasis Reverse Osmosis (Spot-Free Rinse System) is engineered to deliver low-pressure, spot-free water to the car wash bays. The system can be installed on any existing car wash, as well as new installations. Years of trouble free service, with little maintenance, can be expected. The following equipment is included in your Reverse Osmosis Pumping and storage unit.

1. Oasis Plastic Product Water Storage Tank
2. Charcoal Filter
3. Chlorine Test Kit
4. 10' ½" Product Hose
5. R.O. Owners' and Installation Manual

The following should be installed for the R.O. Unit by its appropriate installer:

1. 30 Amp 208/230 Volt 3 Phase, ground and other electrical hook-ups as required by local Electrical Codes and City Ordinances.
2. 1" water supply Line. This line should be taken off of the existing water softener to provide softened water to the R.O. Unit.
3. ¾" Drain Line.
4. A clean 34" x 34" x 79" floor and working space for the R.O. Unit and Plastic Tank.

After the preceding has been provided for the LPS, according to all local, state and national codes and Ordinances, the LPS are now ready to be installed.

SYSTEM INSTALLATION

1. Position the plastic tank in the equipment room. The area should be clean and free of dirt and debris, so as not to damage the plastic tank.
2. Place the charcoal filter between the softened water supply and R.O. Unit. Hook up the incoming water into the inlet side. Turn on the water supply, and allow the unit to flush with water for at least 10 minutes, or until the water coming out of filter outlet is clean and clear. Turn the water supply off.
3. Install an appropriate hose from the outlet side of the charcoal filter to the inlet hook-up on the R.O. Unit. This connecting point is located on the back of the R.O. Unit, behind the 1-1—psi pressure gauge.
4. On the back of the R.O. Unit control panel is a blue $\frac{1}{2}$ " hose that attaches to the top of the plastic tank. This hose provides a route for the spot-free water to get from the R.O. Unit to the storage tank.
5. On the back of the R.O. Unit control panel is a red $\frac{1}{2}$ " hose that goes to the $\frac{1}{4}$ " drain provided for the unit.

This water can be returned to the wash tank if desired. If used an overflow must be provided in wash tank.

6. Inside the R.O. Unit control box is a 4-conductor cable coming from the computer. This control cable goes to the float switch, located in the fiberglass storage tank. The proper connection sequence is as follows (Also See Appendix B):
7. Install a 1" line between the outlet of the plastic storage tank (lower fitting) and the inlet side of the delivery pumps (elbow located on top of pump).

REVERSE OSMOSIS OPERATION

Once your Oasis RO System is on-line, the day to day operation is very simple.

You should check the salt level in the brine tank daily and add salt as required. Once per week test to ensure the water is free of chlorine. This can be checked from the test cock located on top of the carbon filter. You should also check the water for hardness to ensure the proper operation of the water softener. Water must be at zero grains hardness. During normal operation, the system will operate automatically and does not require any further attention.

The Oasis RO System is basically two systems in one. The first system produces pure water. The other system delivers the pure water to the wash bays.

RO MEMBRANE SYSTEM

The RO Membrane is nothing more than a very fine filter. This filter (membrane) is so fine that it simply removes the minerals from the water and allows only the pure water to pass (permeate) through the membrane.

Since the membrane is so fine, a pump must be used to pressurize the water to approximately 200 PSI to force the water through the membrane. As with any filter, after time the membrane could become clogged (fouled) with minerals, grease or dirt and not allow any further passage of the pure water through the membrane and into the holding tank. Since the membranes are very fine and fouling can occur, a water softener is used to soften the incoming water and the carbon filter is used to remove the chlorine. Chlorine will damage the membrane, and prolonged exposure can cause permanent damage.

To keep fouling from happening, a certain amount of water must be used to flush past the surface of the membrane and rinse the build-up of minerals from the membrane surface. This water is then recirculated through the membrane pump system and used over. After several passes by the membrane, the recirculating water becomes very saturated with minerals. It must therefore be discarded. To ensure smooth continuous operation, an orifice is located in the recirculation system and a controlled amount of water is rejected from the system to drain (reject water) on a continuous basis as long as the membrane pump is running. The amount of reject water is controlled by the orifice located in the plumbing in the lower portion of panel. See schematic for its location. The amount of reject water is set at the factory and should only be changed after consultation with the factory. The amount of water going to drain can be monitored in the REJECT WATER FLOW METER.

The pure water (PRODUCT WATER) that permeates through the membrane is then stored in the stainless steel product water holding tank. As the water level reaches the top of the tank a float switch will shut off the membrane pump, thus stopping the production of pure water. Once the water level is reduced a sufficient amount, the float switch will start the membrane pump and once again fill the tank with pure water.

If you operate the Oasis system 24 hours per day you will find that the water softener will regenerate at approximately 2 o'clock AM. The system will receive city water to the Oasis system during the time that the water softener regeneration takes place. This should be avoided. **Do not allow the storage system to run at this time, as it will cause membrane damage.** The normal regeneration time is about 2 hours. You may wish to check the softener manual for more detailed information concerning the operation of the water softener.

DELIVERY SYSTEM OPERATION

The Delivery System consists of a pump capable of producing pressure up to approximately 150 PSI using the water from the pure water holding tank. The electric control panel and wash bay switches control the pump. Should the water level fall below the low water level switch in the water holding tank, the delivery pump shuts off until the water level is restored.

INSTALLATION & OPERATION INSTRUCTIONS

This Oasis RO system is pre-plumbed and wired for easy installation and start-up. Once this system is on-line, very little preventative maintenance is required.

1. Chlorine test weekly. The chlorine level should remain at zero to prevent permanent damage to the RO Membranes.
2. Water hardness test weekly. The water hardness should remain at zero, to prevent premature fouling of the RO Membranes.
3. Sediment filter checked weekly (visual inspection).

INSTALLATION

1. Select a location where the required utilities are easily accessible.
2. Check the incoming water pressure prior to installing the RO System. Should the water pressure be less than 40 PSI, a booster pump may be required (consult factory). If the incoming water pressure exceeds 100 PSI it will be necessary to install a pressure-reducing valve.
3. Normal electrical requirements for this system are 240/480 volt 3-phase 10/20-amp service. Controls are located in the main electrical enclosure.
4. Make the drain line connection (1/2 inch) to a floor drain near the RO system. Should a drain not be available in close proximity to the RO system, you can run the drain line overhead to a drain located elsewhere in the building (Max height 8' above base). Please refer to sketch for the location of this connection.
5. The final connection to make is the pure water connection from each wash bay to the RO manifold located on the upper right end of JETSTREAM MODULE.

START UP INSTRUCTIONS

1. Charging the system with water is the first step in starting up the RO system. Check to be sure that the manual service valve is in the off position (customer supplied).
2. Make sure the power is turned off.
3. Install a temporary jumper wire between terminal number 5 and number 76 (solenoid valve).
4. Remove sediment filter and housing, being careful to not lose the o-ring.
5. Turn off the 3-phase contactor for RO storage pump.
6. Turn on the power to control panel.
7. Partially open the service valve to flush the dust out of the charcoal tank. If this step is skipped, you may cause the sediment filter to foul prematurely.
8. Allow charcoal filter to flush slowly for approximately fifteen minutes.
9. Close the service valve therefore shutting off the water supply, turn off control power and then remove the jumper between terminal number 5 and number 76.
10. Reinstall the sediment filter and housing.
11. Turn on control power.
12. Caution! Make sure water softeners have been regenerated before charging system (water should test 0 grains hardness).
13. Make sure the ½" permeate pure water hose is connected to the bottom plumbing of the pure water holding tank.
14. Turn off the RO 3-Phase contactor. This will enable the storage pump and allow water to flow and expel all air from the system (air bubbles can be seen through flow meters on front door).
15. The upper float switch in the pure water holding tank must be in the down position.
16. Turn on the service valve slowly, checking for air bubble again in flow meters.
17. Now check pump for correct rotation by watching shaft (may be seen at about mid position of storage pump), while someone else bumps RO pump contactor momentarily.
18. See pump for correct rotation. CAUTION! Do not run pump for more than 5 seconds in the event rotation is wrong, as this can cause severe damage to the pump. When the rotation is correct, the PUMP CONTACTOR can now be turned to run position. The high-level float switch must be in the down position for the pump to run. There is about an 8 second delay before the pump will start.
19. Once the system is producing water, adjust the pressure to about 200 PSI. See Schematic for pressure regulator location.
20. Water should begin to fill the pure water holding tank.
21. Make sure the high-level float switch will shut the system down automatically. Manually raise this switch by hand, which should shut down the system. Again lower the high-level float switch and the system will restart after the 8-second delay.
22. While the storage tank is filling, use the water test kits. Take a sample of water from the water sample valve and check for chlorine and hardness. It is extremely important that the RO membrane(s) be supplied with chlorine-free, soft water. Both of the readings should be zero. If they are not, discard the water in the storage tank until the water becomes pure.
23. After the storage tank has filled with pure water, make sure the hand valve in the supply line to the delivery pump from the storage tank is fully open.
24. The RO System is now in full automatic operation.

TROUBLE SHOOTING GUIDE

1) Product flow is less than normal, pressure normal and water with water temperature at approximately 78 deg F

* CAUSE: RO membrane(s) fouled.

* SOLUTION: Membrane(s) should be cleaned. CONSULT FACTORY.

2) Product flow higher than normal and pressure normal with water temperature at approximately 78 deg F

* CAUSE: Membrane(s) damaged.

* SOLUTION: Repair or replace. The membrane life is approximately three to five years depending on service duty.

3) Storage pump will not start.

* CAUSE:

- a) Control panel circuit breaker has tripped.
- b) Motor overload has tripped.
- c) Float switch is stuck or defective.
- d) Motor has become defective.
- e) High-level float switch is stuck or defective.

* SOLUTION:

- a) Reset circuit breaker.
- b) Reset motor overload.
- c) Repair or replace.
- d) Repair or replace.
- e) Repair or replace.

5) Delivery pump will not start.

* CAUSE:

- a) Control panel circuit breaker has tripped.
- b) Motor overload has tripped.
- c) Motor has become defective.
- d) Pressure switch is not working.
- e) Low water level in holding tank.
- f) Low-water switch is defective.

* SOLUTION:

- a) Reset circuit breaker.
- b) Reset motor overload.
- c) Repair or replace.
- e) Repair or replace.

6) No delivery pressure.

- * CAUSE:
 - a) See step number 5.
 - b) Insufficient amount of water in storage tank.
 - c) Delivery pump is damaged.
 - d) Pump is running in the wrong direction.
- * SOLUTION:
 - a) See step number 5.
 - b) Allow time for tank to fill.
 - c) Repair or replace pump.
 - d) Change motor rotation if required, at time of installation only.

7) No storage pressure.

- * CAUSE:
 - a) Low incoming water pressure.
 - b) Float switch is defective.
 - c) Lost power to pump.
 - d) Pump is running in the wrong direction.
 - e) Motor has become defective.
 - f) System water leaks.
- * SOLUTION:
 - a) Incoming water pressure should be between 40 and 100 PSI.
 - b) Repair or replace.
 - c) Replace fuse or reset overload.
 - d) Change motor rotation if required at time of installation only.
 - f) Repair or replace.
 - g) Repair or replace failed plumbing.

8) Storage pump short cycles on and off.

- * CAUSE:
 - a) Sediment filter dirty.
 - b) Insufficient water flow/pressure.
- * SOLUTION:
 - a) Replace.
 - b) Check incoming water supply (40-100 PSI required).

METER AND SAFE INSTALLATION

In most cases the meter and safe installation should be accomplished before bricking the car wash. Determine the desired set up of the meter and safe combination before starting the installation process.

The typical set-up is one meter for one safe, or two meters for one safe. The safes should be mounted in a very visible location. This is one of the best deterrents against theft and vandalism.

1. After determining the proper heights and attaching points of the meter and safes, have a qualified welder weld each item in place.
2. Install 1-1/2" PVC male adapters to the meter and safe openings. Route flexible PVC tubing between the meter and safe. (See Diagram)
3. Install a minimum 1" EMT from the pre-punched hole in the top of meter box to above the wall height. This will provide routing for the low voltage control cable to the meter.
4. Hook up a 19-conductor, 18 gauge cable from each meter to the control panel on the Jet Stream.

BOOM INSTALLATION

Two booms are provided for each bay. The first boom is the 360 degrees ceiling-mounted boom for high and low pressure functions. The second boom is a 180 degrees wall-mount boom for the foaming brush function.

1. The location of the 360 degrees ceiling boom is not always in the center of the bay. Depending on the size of the bay, it is customary to mount the boom offset to the side where the wand holder will be. This causes the hose to be closer to the wand holder, therefore having less chance of cars catching the hose with their mirrors. Please mount the booms with at least a 3/8" bolt to insure good strength for holding up the boom.
2. The 180 degree boom is normally located on the wall opposite the coin meter. The boom is normally mounted on the wall so that the arm is not at the same height of the 360 degrees ceiling mount boom. The 180 degrees boom arm is the lower boom, but please check the boom arm swing to insure that it does not interfere with light fixtures, the 360 degrees boom, or other objects.

Mount the bracket on the wall, noticing that the slotted hole on the bracket is at the bottom. Also install the boom bracket bumpers at the top hole. You can adjust the slope of the bracket with the slotted holes, so that the boom will usually fall in the direction of the flow of traffic through the bay.

3. Mount the foam generator on hose feeding the brush boom and boom manifold on the 360 degrees boom. Install all bay hoses on booms now, but do not install brushes or trigger guns.

LINE INSTALLATION

According to the selections of the system that is being installed, there must be a delivery line from each product to each bay: high pressure wash, pre-soak systems can be tied together, and only one line run to the boom manifold.

1. Begin the line installation in the equipment room, working from there out to the farthest bay (See Diagram).
Leave plenty of extra hose at the boom connection for the boom manifold hook-up.
2. Using straps, attach all lines to a stabilized structure of the car wash building.
3. Cut length at equipment room leaving plenty of extra hose for equipment connection.

It is a good procedure to separate all hoses for a particular bay, and mark them accordingly.

4. Continue working to the next farthest bay following the Steps 1-3, above. Attach all hoses to the support structures as they are being installed.

If the equipment storeroom is in between bays, work one side, installing hoses, then proceed to the other side of the equipment room.

AIR COMPRESSOR INSTALLATION

1. Clear out an area for air compressor.
2. Remove the air compressor from its crate.
3. Place the compressor in the equipment room, approximately 2-4" from the wall.
4. Check the oil in the compressor, and fill to its proper level.
5. Bolt the air compressor to floor, if it is an upright model.
6. Instruct the electrician to run the proper size electrical service to air compressor.
7. Instruct the plumber to run a 1/2" air line from the air compressor to the Jet Stream.
8. Install a 3/8" air filter on the air line to remove moisture and debris from the air supply.
9. Hook the air hose from the Jet Stream to the air filter.

SIGN INSTALLATION

Please refer to the included drawing for the proper layout of your signs. Most signs are installed against a brick or masonry wall with a plastic nail-in anchors. This anchor does not have a screw, but instead a nail. Simply place a sign on wall, mark the holes and nail in the anchors with a hammer. Repeat this procedure for all signs.

REVERSE OSMOSIS UNIT CHECK-OUT PROCEDURE

Before continuing installation, perform the following checks:

1. Turn on the water supply valve, and check for leaks of any kind. If any are found, turn off the valve, repair the leak, and retest. The water pressure should read between 20-60 psi, at the 0-100 psi gauge, depending on the city water pressure.
2. Perform a chlorine test according to the instructions provided in the test kit. If any trace of yellow is found, re-check the installation of the charcoal filter for a reversed hook-up. Properly install the charcoal filter, and retest. If the charcoal filter is properly installed, and the chlorine test fails again, the charcoal filter is defective and must be replaced.
3. Check the electrical voltage at the breaker, and verify that 208/230 Volts 3 phase is provided to unit.
4. Check that the drain hose has been connected from R.O. Unit to drain.
5. Check to see that both the "run" and "power" lights on the computer are lit.

REVERSE OSMOSIS UNIT TURN-ON PROCEDURE

Now that the Reverse Osmosis Unit is installed, spot-free water can be produced. Turn the power to the R.O. unit on, and the unit should start to produce spot-free water (Product Water). There should be a supply of water going to the polyethylene storage tank, and a small amount of water coming out of the drain hose (Reject Water). The pressure gauge on the front of the R.O. control panel will indicate the product supply pump pressure. It should read between 180 and 200 psi. The unit should run for several minutes, allowing air to escape the system.

Do not make any adjustments until the unit has been turned on for about 10-15 minutes. This unit was factory run and tested, and should be adjusted properly.

Never exceed 225 psi, or damage will occur to the R.O. Unit pump and membrane.

You will notice that, even though you keep increasing the pressure, the product water does not increase; only the reject water decreases. At this point, by increasing the pressure you are only working the membranes harder and harder, but yet, not producing any more water. A lot of systems typically run at 180-200 psi.

REVERSE OSMOSIS UNIT RATINGS

Typical recovery rates and settings for a Jet Stream R.O. System are as follows:

System Size GPM	Product Water		Reject Water	
	Minimum GPM	Maximum GPM	Minimum GPM	Maximum
1500 GPD System	.7	1.25	.25	.5
3200 GPD System	1.6	2.6	.5	1.0
4800 GPD System	2.5	3.5	1.0	1.5

Never exceed the above listed recovery rates, or severe fouling will result, and the membrane warranty will be void. It is better and most economical to have a high rate of reject water, than to take a chance in damaging the membranes by pushing the R.O. Unit too hard.

If the unit is not producing the anticipated amount of product water, the following factors can usually be contributing to its failure:

- A. TDS (Total Dissolved Solids) above 300 PPM
- B. Water temperature is too cold
- C. Hard Water

Once the fiberglass tank has about 2-3' of water, you will need to prime the delivery pump. To do this, simply loosen the hose fitting on the discharge side of the pump, allowing water and air to flow through the pump until all air is purged from the line.

If there are any problems in setting up this unit, or any questions concerning it, contact the factory at (316) 783-1355.

JET STREAM TURN-ON PROCEDURE

Plumbing

1. Inspect each Hydrominder in each chemical tank for the proper metering tip. Position the drums of chemical in their proper place, and insert the hydrominder suction hose.
2. Turn on the city water at the main valve, and purge all air from the softener, heater and lines.
3. When water enters the tank, the Hydrominder will dilute the chemical to the proper amount for each service.
4. Once the Jet Stream has water in all chemical tanks and the hot water tank, and pressure to rinse the manifold, you can turn on the power to bays.
5. You can now turn on air for the air compressor to the Jet Stream.
6. At each bay, remove all spray tips from trigger guns.
7. Turn on each bay, selecting rinse first. After running the pump on rinse for 2-3 minutes, switch to wash, wax and each low pressure function. Allow each product to thoroughly flush lines.
8. Now install all tips, and allow the pump to build up pressure. The pumps have all been tested at 1000 psi, and low-pressure functions have been set. Please refer to the pressure-setting chart, should adjustments need to be made on low-pressure functions. Keep in mind that this chart is the normal setting, but you can adjust to suit your personal preference. A rule of thumb on low-pressure settings is that air pressure; the symptom will be that the product is very irregular coming out of the trigger gun.
9. Test all coin mechanisms for coin acceptance, and all timers for proper operation.
10. It is very important that you test every function on every bay to insure that no lines are crossed and that the proper product is being dispensed properly.
11. Once you open up the car wash, please have someone monitoring the location closely for the first several days to insure proper operation.

Jet Stream Pressure Settings

	Liquid	Air	Hydrominder Tip
Pre-Soak Medium Pressure	325	~~50~~	Red
Whitewall	50	40	Grey
Brush	40	30	Blue
Wax	50	30	Red

High Pressure Pump-1000 PSI @ 3.5 GPM

#7 Tip

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OPERATING INSTRUCTIONS

Once the Jet Stream has been installed according to the installation instructions, it should be operated with caution. The equipment is designed to be coin-operated, and the proper operation is as follows:

1. Holding the trigger gun firmly in your hands, deposit coins in to the coin meter.
2. Turn the selection dial to "PRE-SOAK".
3. Squeeze the trigger on the safety gun. The pre-soak is delivered at medium pressure through the trigger gun. Always direct the stream of spray away from your body, and toward the vehicle. Spray the entire vehicle with pre-soak.
4. When you've completed the pre-soak spray, turn the selection dial to "TIRE CLEANER". The tire cleaner is delivered at low pressure through the trigger gun. Apply this chemical to the tires of the vehicle.
5. After applying tire cleaner, turn the selection dial to "HIGH PRESSURE WASH". The wash detergent is delivered at 1000 psi through the trigger gun. Always direct the stream of spray away from your body, and toward the vehicle. Avoid spraying in the direction of other person; serious injury could result if caution is not used when operating this equipment.
6. When the vehicle has been completely washed, turn the selection dial to "FOAM BRUSH". Put the trigger gun into the wand holder, mounted on the bay wall. The foam brush chemical is delivered at low pressure, through the foaming brush assembly. Grasp the brush handle firmly, and scrub the vehicle with the foaming brush. Return the brush to its holder upon completion.
7. Grasp the trigger gun firmly, and turn the selection dial to "RINSE". Rinse water is delivered at high pressure through the safety trigger gun. Rinse all foam and chemicals from the vehicle.
8. Turn the selection dial to "WAX". Wax is delivered at high pressure through the trigger gun. Spray wax over the entire vehicle, except for glass windows.
9. After the wax application, turn the selection dial to "SPOT-FREE RINSE"; the Spot-Free Rinse is delivered at low pressure through the trigger gun. Spray this rinse water over the entire vehicle.
10. When all functions have been completed, turn the selection dial to "OFF", and return the trigger gun to the wand holder, mounted on the bay wall.

IMPORTANT SAFETY INSTRUCTIONS

WHEN USING THIS PRODUCT, THE FOLLOWING BASIC PRECAUTIONS SHOULD ALWAYS BE FOLLOWED.

1. Read all instructions before using this product.
2. To reduce risk of injury, close supervision is necessary when a product is used near children.
3. Know how to stop the product, and how to bleed pressures quickly. Be thoroughly familiar with the controls.
4. Keep operation area clear of all persons.
5. Do not attempt to reach over equipment, or to stand on any unstable support. Keep good footing and balance at all times.
6. Follow the maintenance instructions specified in this manual.
7. Disconnect all power before installing or servicing this equipment. If the power disconnect is out of sight, lock it in the open position, and tag it to prevent unexpected application of power. Failure to do so could result in fatal electrical shock.
8. All wiring should be done according to local, state and federal electrical codes.
9. A qualified electrician should do all wiring.
10. This equipment must not be used in potentially dangerous locations, such as flammable, explosive, or chemically laden areas, or in a wet atmosphere.

GROUNDING INSTRUCTIONS

This product must be connected to a grounded, metal, permanent wiring system, or an equipment grounding conductor must be run with the circuit conductors and connector to the equipment-grounding terminal or lead on this product. Use only copper conductors.

A qualified electrician should do all wiring. To ensure a proper ground on the grounding, a qualified electrician must check the means.

This equipment is intended for general use, only. It must not be used in potentially-dangerous locations, such as flammable, explosive, or chemically laden areas, or in a wet atmosphere.

USER MAINTENANCE INSTRUCTIONS

This equipment contains various safety devices that require maintenance to ensure proper operation..

The plumbing equipment has a regulator to properly control the pressure of the pumps. The regulator should be checked weekly for proper operation.

If the pressure regulator should fail, there is a back-up safety pressure pop-off valve, which will open up to bleed off pressure. The pop-off valve is intended for a back-up system, only. If you notice that it has opened up, and begun to bleed pressure, you should immediately repair or replace the pressure regulator.

The trigger gun in the wash bay should be checked daily for proper operation. Replace the trigger gun if it is leaking, sticking or binding.

Refer to the suggestion "MAINTENANCE SCHEDULE" (Page 6).

MAINTENANCE SCHEDULE

- | | |
|-----------|---|
| Daily | <ul style="list-style-type: none">- Check level of chemicals in all drums. Replace with full drums, as needed.- Check all safety trigger guns for proper operation.- Drain water from air filter on air compressor.- Drain water from bottom of air compressor tank. |
| Weekly | <ul style="list-style-type: none">- Check oil in all pumps.- Check cat regulators for proper operation. |
| Monthly | <ul style="list-style-type: none">- Check pressure on R.O. Membrane.- Check chlorine in incoming water going to R.O. system.- If chlorine is present, check carbon filter, and replace if needed.- Check pressure before and after paper filter when unit is running. If pressure differs 10 psi or more, clean or replace paper filter. |
| Bi-yearly | <ul style="list-style-type: none">- Change oil in all pumps. Use cat oil. Do not use a recycled oil product.- Check pressure on all pumps, and adjust as needed.- Check belts, and tighten as needed.- Change oil in air compressor. |
| Yearly | <ul style="list-style-type: none">- Change oil in all pumps.- Change seals in pumps, as needed.- Lubricate the circulating pump on water and under floor heaters.- Change oil in air compressor.- Check all foot valves on Hydrominder, and replace as needed.- Check and clean all dilution tips on Hydrominders. |

JETSTREAM SPARE PARTS

BAYS

A 7354	H.P. Boom Hose
A 7353	Foam Brush Hose 14'
A 3470	Trigger Gun w/weep
A 7348	Flexwand 18"
A 2517	Brush Hog Hair
A 2524	Brush Handle
A 7351	Swivel 90 Degree 5,000 PSI
A 7350	Swivel H.P. (wand)
A 7352	Swivel F.B. Handle

CONTROL ROOM FLUID & AIR

A 2474	3/8"Dema Valve Repair Kit
	1/2" Goyen Valve Repair Kit
A 3446	Air Regulator
A 5448	Fluid Regulator
A 7045	1/2" Check Valve
A 2456	3/8" Check Valve
A 6359	1/4" Check Valve
A 6891	Procon Pump
A 4986	Press Regulator

ELECTRICAL

A 2807	Rectifier
A 7313	Float Switch
A 2160	1/4" Poly Nat. (20 foot)
A 3609	1/4" Pushlock Union (4)
A 3610	3/8" Pushlock Union

INSTALLATION

1. Clean the equipment room, position approximately 24"-30" from the wall.
2. On the bottom of the frame are leveling bolts, so that you can level the unit as much as possible.
3. The unit consists of all high pressure and low-pressure functions, with control panel.
4. Instruct your plumber to provide hot soft water to the hot water tank, and cold soft water to the rinse manifold and chemical tanks. He will need to provide a 1" hot soft water line to the hot water tank, and a 3/4" cold soft water line to the rinse manifold.

Backflow prevention is required for this equipment. This unit does not include any backflow prevention devices. Please install a suitable, approved backflow device at the incoming water supply into the building.

5. This unit must be hooked up by a qualified electrician.
6. The electrician should provide an individual 3-phase circuit to the large control panel for each pump. He will need to tie the three-phase power into the top of each motor starter. If your unit has 3 HP 3 phase motors you will need a 20 Amp breaker, if your system has a 5HP 3 phase motor, the load is 15.0 Amps per bay, or a 30 Amp breaker. In addition to the bays, the electrician will need to provide an 110V single-phase control circuit to the 300 VA transformers located in the bottom of the panel. The circuit breaker must be a 20 Amp breaker for the transformer. The 110V circuit must be connected to the red and white (white is the common) terminal strip shown on the electrical schematic. If your unit has Spot-Free Rinse, please also provide a 220V 3-phase 20 Amp breaker to the motor starter for this function.

INSTALLATION MANUAL

The following chart shows the HP breaker size and wire size.

HP	Phase	Breaker	Wire Size
3	1	30 Amp	10
5	1	40 Amp	8
3	3	20 Amp	12
5	3	30 Amp	10

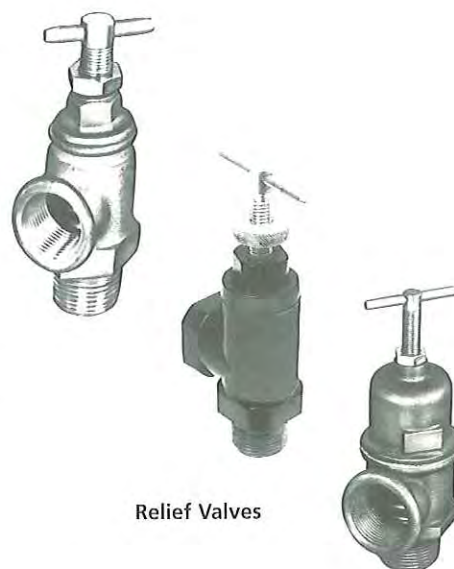
Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

DaytonTM Relief Valves

Description

Dayton relief valves permit pressure to build up to a preselected point in the discharge plumbing, then bypass liquid back to the supply tank while maintaining the set pressure. They are designed to prevent damage to positive displacement type pumps (piston, gear, roller, etc.) where discharge blockage or shut-off can occur during pumping operation. They maximize system performance and protection.

All models handle nonflammable liquids that are compatible with valve material. Maximum operating temperature is 180°F. Nylon models feature a free-floating valve seat and the bronze models feature a stainless steel ball with extra-large valve passage to handle full flow from the supply line. The valve selection range below is from 0 - 600 psi in two materials of construction. A pressure setting securely locks in place with a locknut. These valves can be operated in any position. Not for hot water heaters, boilers, or steam service. **NOTE:** Valves are not designed for complete shut-off. Some bypass may occur.



Relief Valves

Model Number	Maximum Pressure (psi)	Body Material	Valve Material	Inlet Ports (in.)	Ports (in.)	Max. GPM
3YB63	300-600	bronze	S.S. Ball	3/4 MNPT	3/4 FNPT	6
3YB64	300-600	bronze	S.S. Ball	1/2 MNPT	1/2 FNPT	6
3YB65	150	nylon	nylon	3/4 MNPT	3/4 FNPT	13
3YB66	300	bronze	S.S. Ball	3/4 MNPT	3/4 FNPT	25
3YB67	400	bronze	S.S. Ball	1 MNPT	3/4 FNPT	40
3YB68	250	nylon	nylon	3/4 MNPT	3/4 FNPT	22



Do not use with flammable or explosive fluids.



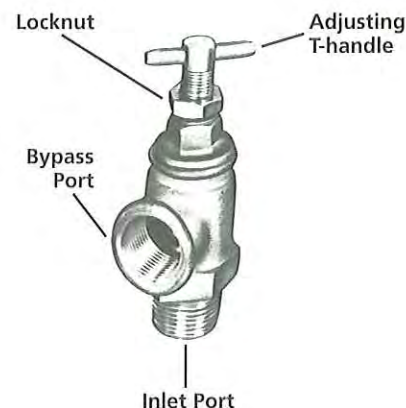
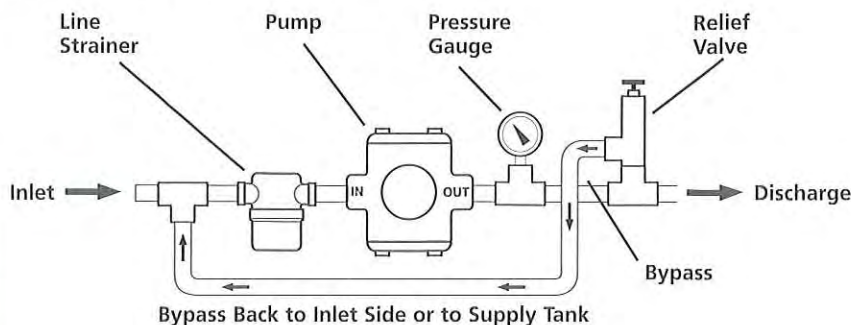
Do not exceed maximum pressure rating of valve.



These relief valves are not intended to be used as safety pressure relief valves for water heaters, boilers, steam service, etc.

Dayton™ Relief Valves

Installation Instructions



Install relief valve on discharge (pressure) side of pump. Plumb the bypass port back to inlet tank or inlet port. Prior to turning pump on, relax spring tension on valve by turning the T-handle counter-clockwise. Stop turning when you feel no resistance.

Turn pump on, then slowly turn the T-handle clockwise until desired system working pressure is reached. Do not use excessive force or wrench on T-handle causing damage to valve. When desired working pressure is reached, snug locknut down on T-handle to hold your pressure setting.

Repair Parts

No repair parts available.

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. Dayton™ Relief Valves, Models covered in this manual, are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use for one year after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at Dayton's option. For limited warranty claim procedures, see PROMPT DISPOSITION below. This limited warranty gives purchasers specific legal rights which vary from jurisdiction to jurisdiction.

LIMITATION OF LIABILITY. To the extent allowable under applicable law, Dayton's liability for consequential and incidental damages is expressly disclaimed. Dayton's liability in all events is limited to and shall not exceed the purchase price paid.

WARRANTY DISCLAIMER. Dayton has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in the "LIMITED WARRANTY" above is made or authorized by Dayton.

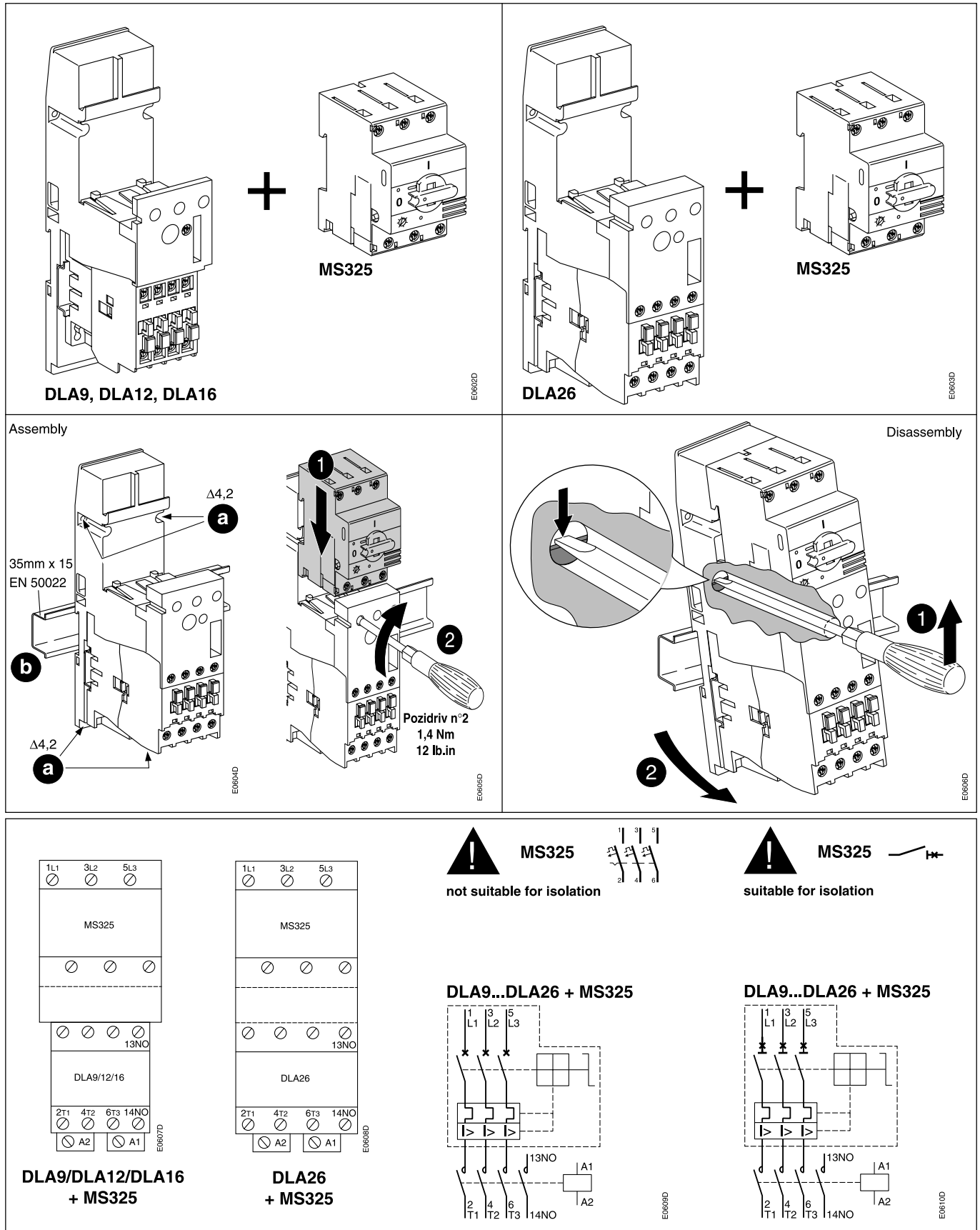
PRODUCT SUITABILITY. Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While Dayton attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.

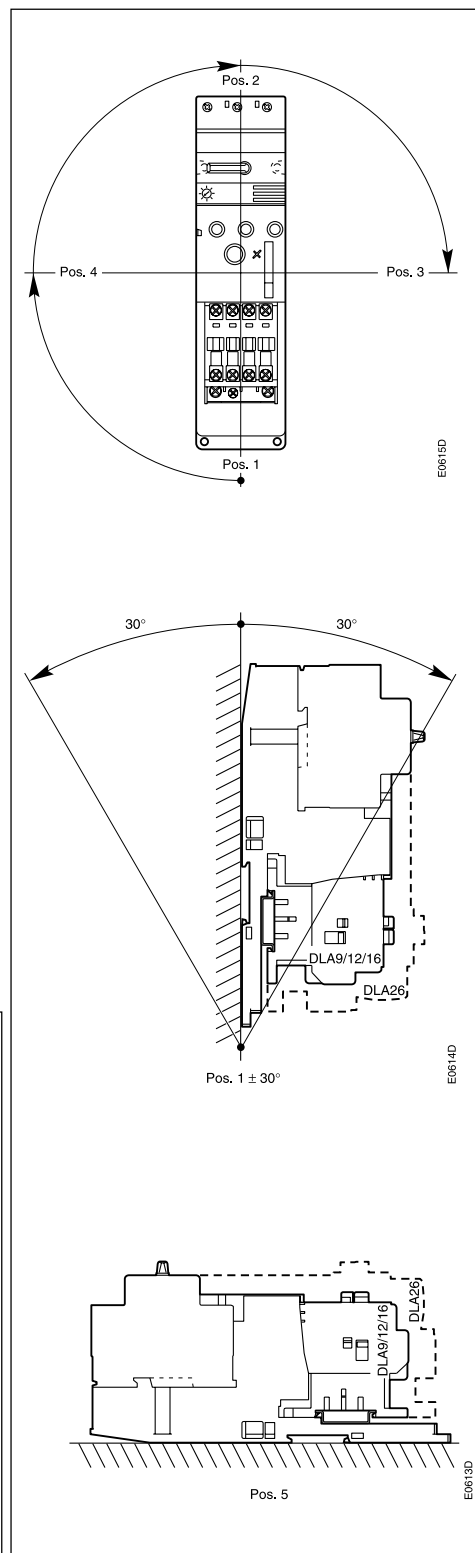
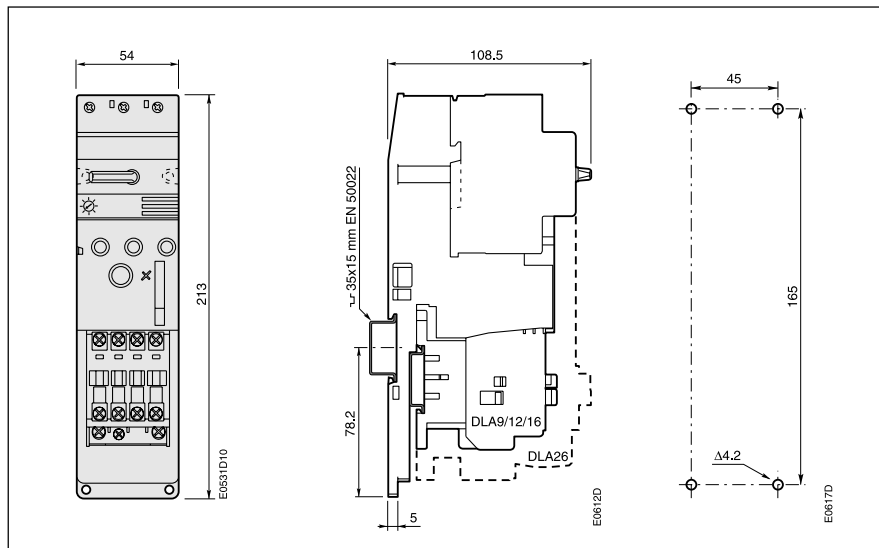
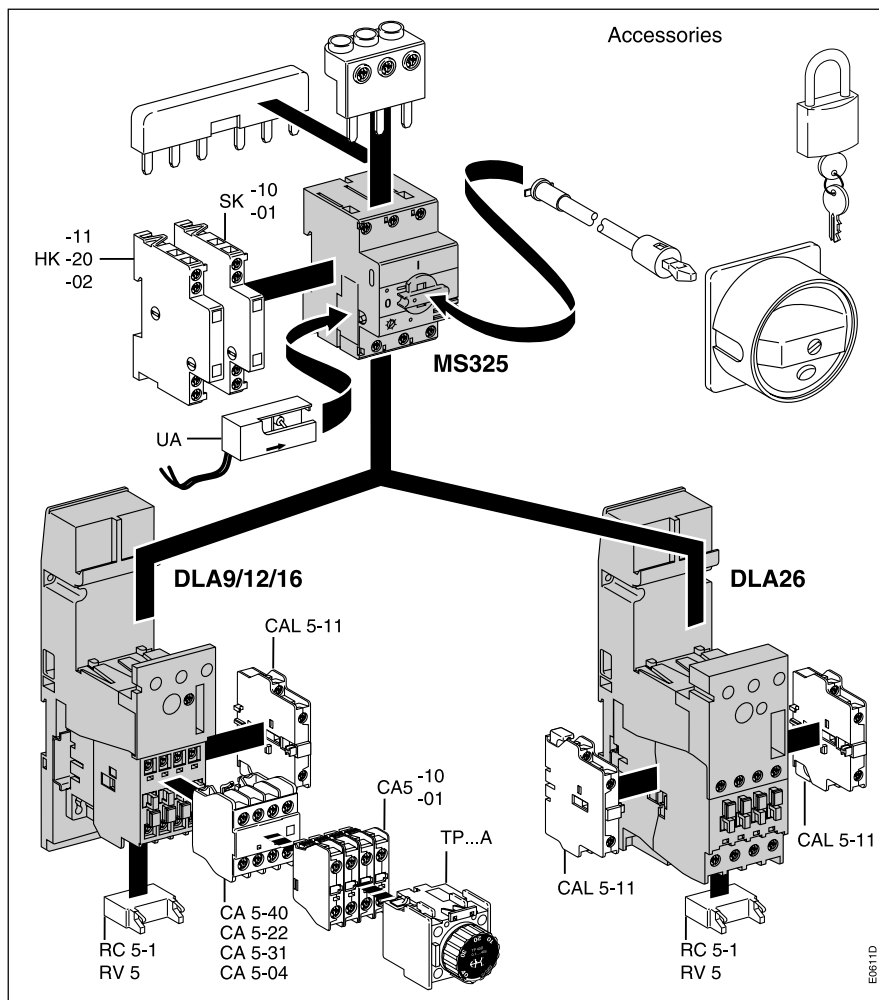
Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequentially the above limitation may not apply to you; and (c) by law, during the period of this limited warranty, any implied warranty of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.

Manufactured for Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714 U.S.A.

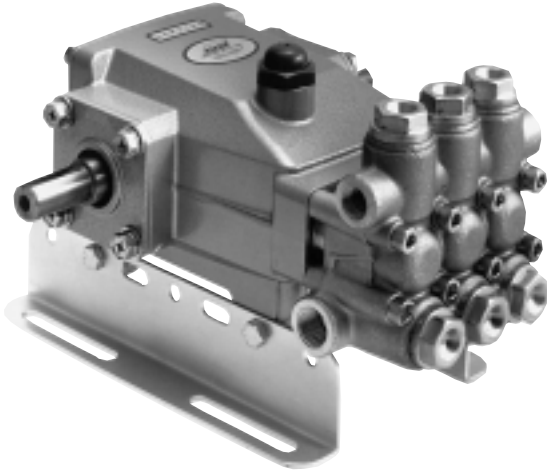
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DLA9 DLA12 DLA16						
	M 3,5 1 N.m 9 lb.in.	Ø 5,5	pozidriv N°2	2 x 1...4 1 x 1...4 2 x 1...2,5	2 x 0,75...2,5 1 x 0,75...2,5 2 x 0,75...1,5	I > 3,5 L < 8
DLA26						
	M 4 1,7 N.m 15 lb.in.	Ø 5,5	pozidriv N°2	2 x 1...4 2 x 1...4	2 x 0,75...2,5 2 x 0,75...2,5	I > 3,5 L < 8

Warning ! The operation, installation and servicing of this appliance must be carried out by a qualified electrician applying the relevant rules of the art, installation standards and safety regulations. Before operating the contactors, check that control voltage complies with the data on the coil mounting bracket. Connection to other control voltage can destroy the coil. Do not touch live parts. Danger !.



FEATURES

Superior Design

- Triplex plunger design gives smoother liquid flow.
- Hi-Pressure Seals are completely lubricated and cooled by the liquids being pumped.
- Inlet and discharge valve assemblies interchange for easier maintenance.
- Lubricated Lo-Pressure Seals provides double protection against external leakage.
- Oil bath crankcase assures optimum lubrication.
- Close tolerance concentricity of the ceramic plunger maximizes seal life.

Quality Materials

- Precision design 304 stainless steel valves and seats are hardened and polished for ultimate seating and extended valve life.
- Forged brass manifolds for strength and corrosion resistance.
- Special blend W770 manifold offers washout and freeze protection for car wash applications.
- Special concentric, high-density, polished, solid ceramic plungers provide a true wear surface and extended seal life.
- Specially formulated, CAT PUMP exclusive, Hi-Pressure Seals offer unmatched performance and seal life.
- Die cast aluminum crankcase provides high strength, minimum weight and precision tolerance control.
- Chrome-moly crankshaft gives unmatched strength and surface hardness.
- Oversized crankshaft bearings with greater loading capacity mean longer bearing life.

Easy Maintenance

- Convenient "press-in" style seal case for ease in servicing.
- Wet-end is easily serviced without entering crankcase, requiring less time and effort.
- Valve assemblies are accessible without disturbing piping, for quick service.
- Preset packings mean no packing gland adjustment is necessary, reducing maintenance costs.

⚠ WARNING

All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). Failure to install such relief devices could result in personal injury or damage to the pump or to system components. CAT PUMPS does not assume any liability or responsibility for the operation of a customer's high pressure system.

5CP Plunger Pump

Models

5CP2120W
5CP2140WCS
5CP2150W

SPECIFICATIONS

U.S. Measure

Metric Measure

MODEL 5CP2120W

Flow 4.0 GPM (15 L/M)
Pressure Range.....100-2500 PSI (7-175 BAR)
RPM 950 RPM (950 RPM)
Bore.....**0.787"** (20 mm)
Stroke 0.709" (18 mm)
Weight 19.14 lbs. (8.7 kg)

MODEL 5CP2140WCS

Flow 4.0 GPM (15 L/M)
Pressure Range.....100-2500 PSI (7-175 BAR)
RPM 1725 RPM (1725 RPM)
Bore.....**0.787"** (20 mm)
Stroke 0.394" (10 mm)
Weight 19.14 lbs. (8.7 kg)

MODEL 5CP2150W

Flow 5.0 GPM (19 L/M)
Pressure Range.....100-2000 PSI (7-140 BAR)
RPM 1725 RPM (1725 RPM)
Bore.....**0.787"** (20 mm)
Stroke 0.472" (12 mm)
Weight 19.14 lbs. (8.7 kg)

COMMON SPECIFICATIONS

Inlet Pressure Range (950 RPM)-5 to 60 PSI (-0.35 to 4 BAR)
Inlet Pressure Range (1725 RPM) ...Flooded to 60 PSI (Flooded to 4 BAR)
Crankcase Capacity.....17 oz. (0.51 L)
Max. Liquid Temperature 160°F (71°C)
Above 130°F call CAT PUMPS for inlet conditions and elastomer recommendations.
Inlet Ports (2).....1/2" NPTF (1/2" NPTF)
Discharge Ports (2) 3/8" NPTF (3/8" NPTF)
Shaft Diameter.....0.787" (20 mm)
Dimensions 10.35 x 10.0 x 5.78" (263 x 254 x 147 mm)

ELECTRIC HORSEPOWER REQUIREMENTS

MODEL	FLOW		PRESSURE				MOTOR PULLEY SIZE	
			PSI 1200	PSI 1500	PSI 2000	PSI 2500	Using 1725 RPM Motor & 8" Std. Pump Pulley	
	U.S. GPM	L/M	BAR 85	BAR 105	BAR 140	BAR 175	RPM	Pulley O.D.
2120W	4.0	15	3.3	4.1	5.5	6.9	950	4.3
Alternate	5.0	19	4.1	5.1	6.9	N/A	1188	5.5
2140WCS	4.0	15	3.3	4.1	5.5	6.9	1725	Direct
2150W	5.0	19	4.1	5.1	6.9	N/A	1725	Direct

DETERMINING

THE PUMP R.P.M.

Rated G.P.M.

Rated R.P.M.

=

"Desired" G.P.M.

"Desired" R.P.M.

DETERMINING

THE REQUIRED H.P.

GPM x PSI

1460

=

Electric Brake

H. P. Required

DETERMINING

MOTOR PULLEY SIZE

Motor Pulley O.D.

Pump R.P.M.

=

Pump Pulley O.D.

Motor R.P.M.

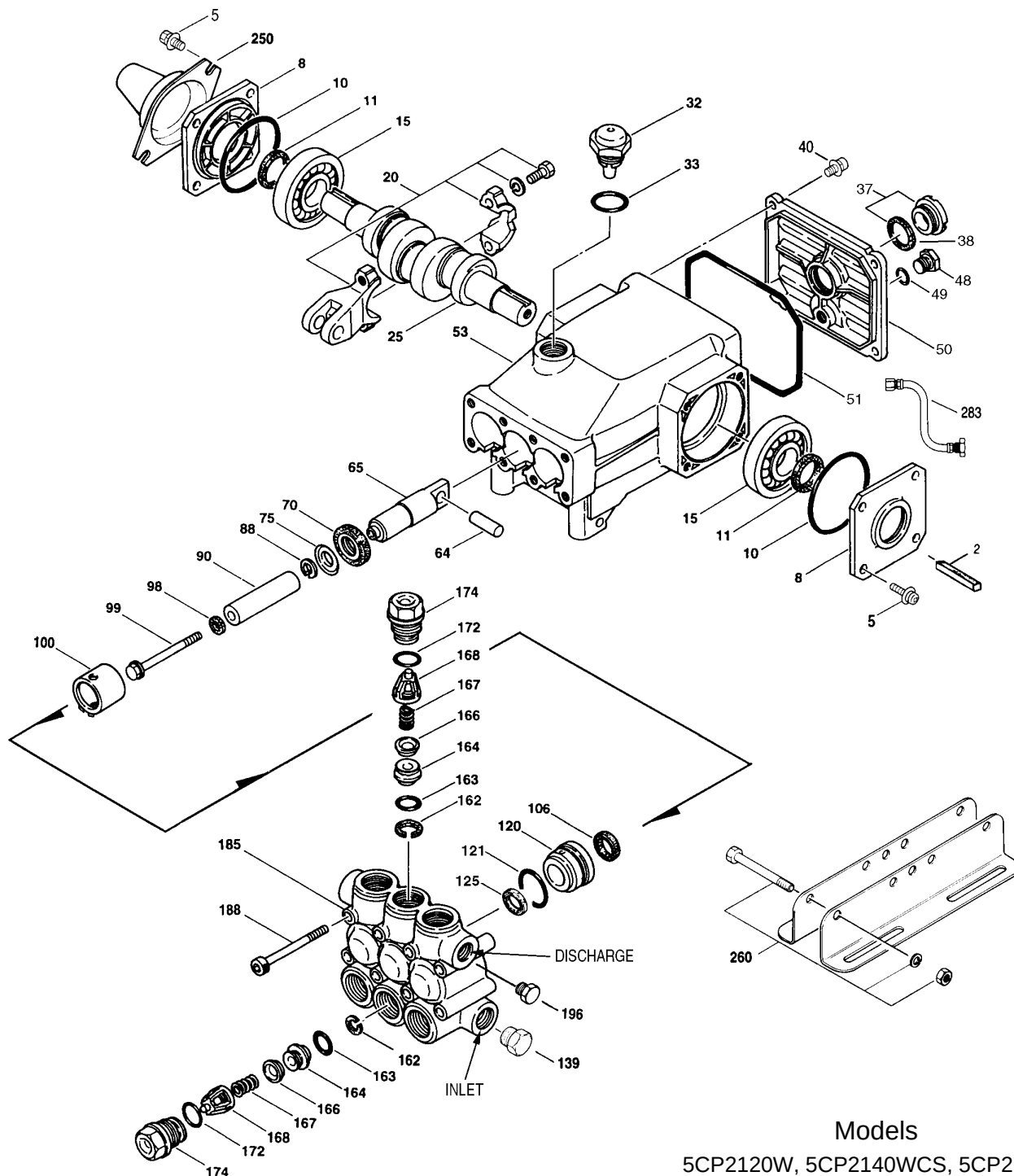
See complete Drive Packages [Includes: Pulleys, Belts, Hubs, Key] Tech Bulletin 003.
Refer to pump **Service Manual** for repair procedure, additional technical information and **pump warranty**.

"Customer confidence is our greatest asset"

PARTS LIST

ITEM	PART NUMBER				DESCRIPTION				QTY
	5CP2120W	MATL	5CP2140WCS	MATL	5CP2150W	MATL			
2	30057	STL	30057	STL	30057	STL	Key (M6x6x25)		1
5	96031	STZP	96031	STZP	96031	STZP	Screw, Sems HHC (M8x16)		8
	126542	STCP R	126542	STCP R	126542	STCP R	Screw, Sems HHC (M8x16)		8
8	46910	AL	46910	AL	46910	AL	Cover, Bearing		2/1
10	14028	NBR	14028	NBR	14028	NBR	O-Ring, Bearing Cover - 70D		2
11	43222	NBR	43222	NBR	43222	NBR	Seal, Oil, Crankshaft		2
15	14480	STL	14480	STL	14480	STL	Bearing, Ball		2
20	48742	TNM	48742	TNM	48742	TNM	Rod, Connecting Assy [10/01]		3
25	46928	FCM	—	—	46982	FCM	Crankshaft, Dual End		1
	—	—	48203	FCM	—	—	Crankshaft, Single End		1
30	—	—	48224	AL	—	—	Cover, Bearing Blind		1
32	46798	—	46798	—	46798	—	Cap, Oil Filler, Domed		1
33	14179	NBR	14179	NBR	14179	NBR	O-Ring, Oil Filler Cap - 70D		1
37	92241	—	92241	—	92241	—	Gauge, Oil, Bubble w/Gasket - 80D		1
38	44428	NBR	44428	NBR	44428	NBR	Gasket, Flat, Oil Gauge - 80D		1
40	92519	STZP	92519	STZP	92519	STZP	Screw, Sems HHC (M6x16)		4
	125824	STCP R	125824	STCP R	125824	STCP R	Screw, Sems HHC (M6x16)		4
48	25625	STCP	25625	STCP	25625	STCP	Plug, Drain (1/4"x19BSP)		1
49	23170	NBR	23170	NBR	23170	NBR	O-Ring, Drain Plug - 70D		1
50	46940	AL	46940	AL	46940	AL	Cover, Rear		1
51	14044	NBR	14044	NBR	14044	NBR	O-Ring, Rear Cover		1
53	48617	AL	48617	AL	48617	AL	Crankcase		1
64	46746	CM	46746	CM	46746	CM	Pin, Crosshead		3
65	48458	BBNP	48458	BBNP	48458	BBNP	Rod, Plunger		3
70	46838	NBR	46838	NBR	46838	NBR	Seal, Oil, Crankcase - 70D		3
75	43328	S	43328	S	43328	S	Slinger, Barrier		3
88	45697	S	45697	S	45697	S	Washer, Keyhole (M18)		3
90	46841	CC	46841	CC	46841	CC	Plunger (M20x50)		3
98	46730	NBR	46730	NBR	46730	NBR	Washer, Seal - 90D		3
	48394	FPM	48394	FPM	48394	FPM	Washer, Seal - 90D		3
	◆ 48432	EPDM	◆ 48432	EPDM	◆ 48432	EPDM	Washer, Seal		3
99	† 48201	SSL	† 48201	SSL	† 48201	SSL	Retainer, Plunger w/Stud (M6)		3
100	46749	PVDF	46749	PVDF	46749	PVDF	Retainer, Seal		3
106	43305	NBR	43305	NBR	43305	NBR	Seal, LPS w/S-Spg		3
	45153	FPM	45153	FPM	45153	FPM	Seal, LPS w/SS-Spg		3
	◆ 48429	EPDM	◆ 48429	EPDM	◆ 48429	EPDM	Seal, LPS w/SS-Spg		3
120	46843	BB	46843	BB	46843	BB	Case, Seal (Press-in-style)		3
121	13978	NBR	13978	NBR	13978	NBR	O-Ring, Seal Case - 70D		3
	14329	FPM	14329	FPM	14329	FPM	O-Ring, Seal Case		3
	◆ 48904	EPDM	◆ 48904	EPDM	◆ 48904	EPDM	O-Ring, Seal Case		3
125	43307	SNG	43307	SNG	43307	SNG	Seal, HPS w/S		3
	44936	FPM	44936	FPM	44936	FPM	Seal, HPS w/SS		3
	46667	HT	46667	HT	46667	HT	Seal, HPS 2-Pc w/S-Support		3
139	22179	BBCP	22179	BBCP	22179	BBCP	Plug, Inlet (1/2"NPT)		1
162	48361	D	48361	D	48361	D	Back-up-Ring, Seat		6
163	43358	NBR	43358	NBR	43358	NBR	O-Ring, Seat - 70D		6
	44938	FPM	44938	FPM	44938	FPM	O-Ring, Seat - 70D		6
	◆ 48908	EPDM	◆ 48908	EPDM	◆ 48908	EPDM	O-Ring, Seat		6
164	43725	S	43725	S	43725	S	Seat		6
166	43723	S	43723	S	43723	S	Valve		6
167	43750	S	43750	S	43750	S	Spring		6
168	44565	PVDF	44565	PVDF	44565	PVDF	Retainer, Spring		6
172	17615	NBR	17615	NBR	17615	NBR	O-Ring, Valve Plug - 75D		6
	15855	FPM	15855	FPM	15855	FPM	O-Ring, Valve Plug - 70D		6
	◆ 48431	EPDM	◆ 48431	EPDM	◆ 48431	EPDM	O-Ring, Valve Plug - 75D		6
174	43849	BBCP	43849	BBCP	43849	BBCP	Plug, Valve		6
185	48245	W770	48245	W770	48245	W770	Manifold, Head - W770		1
188	87872	STZP	87872	STZP	87872	STZP	Screw, HSH (M8x70)		8
	126513	STCP R	126513	STCP R	126513	STCP R	Screw, HSH (M8x70)		8
196	22187	BBCP	22187	BBCP	22187	BBCP	Plug, Discharge (3/8"NPT)		1
250	118672	STCP	118672	STCP	118672	STCP	Protector, Shaft		1
255	30243	STZP	30243	STZP	30243	STZP	Mount, Direct		1
260	30611	STZP	30611	STZP	30611	STZP	Assembly, Angle Rail - B		1
							(Incls: 28499, 30900, 30910, 30920) (Belt Drive Only)		
	30637	STZP	30637	STZP	30637	STZP	Mount, Angle Assy-Retro Fit		1
265	30659	—	30659	—	30659	—	Kit, Complete Mounting		1
							(Incls: 30611, 30633, 118672) (Belt Drive Only)		
275	30944	STL	30944	STL	30944	STL	Hub & Key Assy (M20 w/M6 Keyway)		1
							[See Drive Packages, Tech Bulletin 003]		
283	34334	—	34334	—	34334	—	Kit, Oil Drain		1
298	34970	STZP	34970	STZP	34970	STZP	Clutch, Assy, Single Groove, 20mm, 12VDC		1
	34980	STZP	34980	STZP	34980	STZP	Clutch, Assy, Dual Groove, 20mm, 12VDC		1
299	816650	W770	816650	W770	816650	W770	Head, Complete		1
300	33628	NBR	33628	NBR	33628	NBR	Kit, Seal (Incls: 98, 106, 121, 125)		1
	31628	FPM	31628	FPM	31628	FPM	Kit, Seal (Incls: 98, 106, 121, 125)		1
	◆ 31648	EPDM*	◆ 31648	EPDM*	◆ 31648	EPDM*	Kit, Seal (Incls: 98, 106, 121, 125)		1
	31638	HT	31638	HT	31638	HT	Kit, Seal (Incls: 98, 106, 121, 125)		1

EXPLODED VIEW



Models

5CP2120W, 5CP2140WCS, 5CP2150W

October 2006

	5CP2120W	MATL	5CP2140WCS	MATL	5CP2150W	MATL		
310	30821	NBR	30821	NBR	30821	NBR	Kit, Valve (Incls: 162,163,164,166,167,168,172)	2
	31821	FPM	31821	FPM	31821	FPM	Kit, Valve (Incls: 162,163,164,166,167,168,172)	2
	◆ 31162	EPDM	◆ 31162	EPDM	◆ 31162	EPDM	Kit, Valve (Incls: 162,163,164,166,167,168,172)	2
350	30696	STZP	30696	STZP	30696	STZP	Plier, Reverse	1
400	7850	BB	7850	BB	7850	BB	Modular Unloader (See Individual Data Sheet)	1
—	—	—	8026ES-8042ES	—	8026ES-8042ES	—	BD Motors (See Individual Data Sheet)	1
—	6107	—	6107	—	6107	—	Oil, Bottle (21 oz) ISO 68 Multi-viscosity Hydraulic (Fill to specified crankcase capacity prior to start-up)	1

Bold print part numbers are unique to a particular pump model. Italics are optional items. ◆ Silicone oil/grease required. † Production parts are different than repair parts.
R Components comply with RoHS Directive. [] Date of latest production change. W770 effective with 97 production.

*Review material codes for individual items (HT generally may be used as alternate).

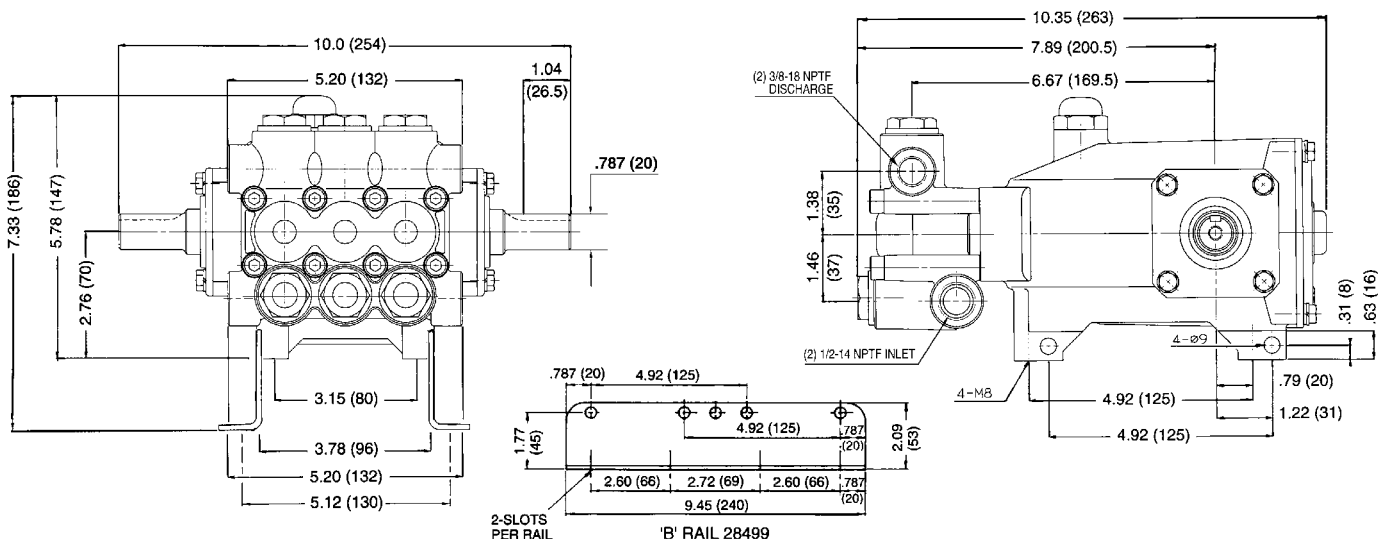
See Tech Bulletins 002, 003, 024, 036, 043, 053, 060, 061, 064, 073, 074, 077, 078 and 083 for additional information.

MATERIAL CODES (Not Part of Part Number): AL=Aluminum BB=Brass BBNP=Brass/Nickel Plated CC=Ceramic CM=Chrome-moly

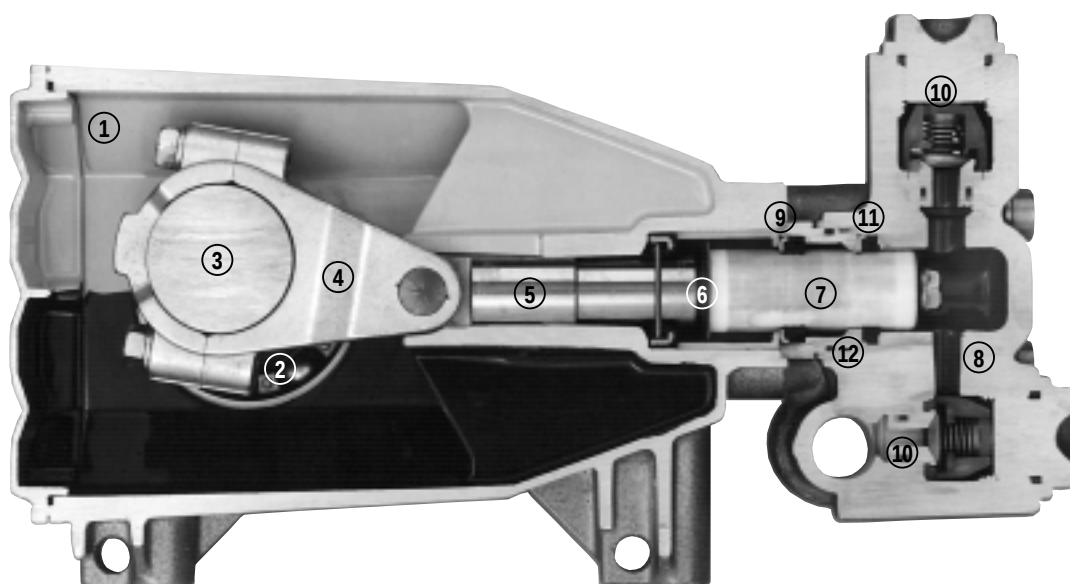
D=Acetal EPDM=Ethylene Propylene Diene Monomer FBB=Forged Brass FCM=Forged Chrome-moly FPM=Fluorocarbon HS=High Strength

HT=Hi-Temp (EPDM Alternative) NBR=Medium Nitrile (Buna-N) PVDF=Polyvinylidene Fluoride S=304SS SNG=Special Blend (Buna) SSL=316SS/Low Carbon STL=Steel

W770=Special Alloy STCP=Steel/Chrome Plated STZP=Steel/Zinc Plated TNM=Special High Strength



Models 5CP2120W, 5CP2140WCS, 5CP2150W



- 1 Die cast aluminum **crankcase** means high strength, lightweight, and excellent tolerance control.
- 2 Oversized crankshaft **bearings** provide extended bearing life and pump performance.
- 3 Chrome-moly **crankshaft** provides unmatched strength and surface hardness for long life.
- 4 Matched high strength **connecting rods** noted for strength and superior bearing quality.
- 5 The **plunger rods** with hardened surfaces offer wear resistance and Zamak cross-heads for high load capacity.

- 6 The stainless steel **slinger** provides back-up protection for the crankcase seal, keeping pumped liquids out of the crankcase.
- 7 Special concentric, high-density, polished, solid ceramic **plungers** provide a true wear surface and extended seal life.
- 8 **Manifolds** are a high tensile strength forged W770 alloy for long term, continuous duty.
- 9 100% wet **seal** design adds to service life by allowing pumped liquids to cool and lubricate on both sides.

- 10 Stainless steel **valves, seats and springs** provide corrosion-resistance, ultimate seating and extended life.
- 11 Specially formulated, CAT PUMP exclusive, **Hi-Pressure Seals** offer unmatched performance and seal life.
- 12 Press-in style **seal case** offers alignment and support for seals and "no tools" servicing.

Products described hereon are covered by one or more of the following U.S. patents 3558244, 3652188, 3809508, 3920356, 3930756 and 5035580

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CP PLUNGER PUMP SERVICE MANUAL



3CP MODELS: 3CP1120, 3CP1130, 3CP1140

5CP MODELS: 5CP2120W, 5CP2140WCS, 5CP2150W, 5CP3120, 5CP3120G1, 5CP3130G1, 5CP5120, 5CP5150G1, 5CP6120, 5CP6120G1, 5CP6140, 5CP6150

7CP MODELS: 7CP6170

INSTALLATION AND START-UP INFORMATION

Optimum performance of the pump is dependent upon the entire liquid system and will be obtained only with the proper selection, installation of plumbing, and operation of the pump and accessories.

SPECIFICATIONS: Maximum specifications refer to individual attributes. It is **not** implied that **all maximums** can be performed **simultaneously**. If more than one maximum is considered, check with your CAT PUMPS supplier to confirm the proper performance and pump selection. Refer to individual pump Data Sheet for complete specifications, parts list and exploded view.

LUBRICATION: Fill crankcase with special CAT PUMP oil per pump specifications (3CP-10 oz., 5CP-17 oz., 7CP-38 oz.). **DO NOT RUN PUMP WITHOUT OIL IN CRANKCASE.** Change initial fill after 50 hours running period. Thereafter, change oil every **3 months or 500 hour intervals**. Additional lubrication may be required with increased hours of operation and temperature.

PUMP ROTATION: Pump was designed for forward rotation to allow optimum lubrication of the crosshead area. Reverse rotation is acceptable if the crankcase oil level is increased slightly above center dot to assure adequate lubrication.

PULLEY SELECTION: Select size of motor pulley required to deliver the desired flow from Horsepower Requirement and Pulley Selection Chart (refer to Tech Bulletin 003 or individual Data Sheet).

DRIVE SELECTION: The motor or engine driving the pump must be of adequate horsepower to maintain full RPM when the pump is under load. Select the electric motor from the Horsepower Requirement Chart according to required pump discharge flow, maximum **pressure at the pump** and drive losses of approximately 3-5%. Consult the manufacturer of gas or diesel engine for selection of the proper engine size.

MOUNTING: Mount the pump on a rigid, horizontal surface in a manner to permit drainage of crankcase oil. An uneven mounting surface will cause extensive damage to the pump base. To minimize piping stress, **use appropriate flexible hose to inlet and discharge ports**. Use the correct belt; make sure pulleys are aligned. Excessive belt tension may be harmful to the bearings. Hand rotate pump before starting to be certain shaft and bearings are free moving.

LOCATION: If the pump is used in extremely dirty or humid conditions, it is recommended pump be enclosed. Do not store or operate in excessively high temperature areas or without proper ventilation.

INLET CONDITIONS: Refer to complete **Inlet Condition Check-List** in this manual before starting system. **DO NOT STARVE THE PUMP OR RUN DRY.** Temperatures above 130°F are permissible. Add 1/2 PSI inlet pressure per each degree F over 130°F. Elastomer or RPM changes may be required. See Tech Bulletin 002 or call CAT PUMPS for recommendations.

C.A.T.: Installation of a C.A.T. (Captive Acceleration Tube) is recommended in applications with stressful inlet conditions such as high temperatures, booster pump feed, long inlet lines or quick closing valves.

DISCHARGE CONDITIONS: OPEN ALL VALVES BEFORE STARTING SYSTEM to avoid deadhead overpressure condition and severe damage to the pump or system.

Install a **Pulsation Dampener** on the discharge head or in the discharge line as close to the head as possible. Be certain the pulsation dampener (Prrrr-o-lator) is properly precharged for the system pressure (see individual Data Sheet).

A **reliable Pressure Gauge** should be installed near the discharge outlet of the high pressure manifold. This is extremely important for adjusting pressure regulating devices and also for proper sizing of the nozzle or restricting orifice. The pump is rated for a maximum pressure; this is the **pressure** which would be **read at the discharge manifold of the pump**, NOT AT THE GUN OR NOZZLE.

Use PTFE thread tape or pipe thread sealant (sparingly) to connect accessories or plumbing. Exercise caution not to wrap tape beyond the last thread to avoid tape from becoming lodged in the pump or accessories. This condition will cause a malfunction of the pump or system.

PRESSURE REGULATION: All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). The primary pressure device must be installed on the discharge side of the pump. The function of the primary pressure regulating device is to protect the pump from over pressurization, which can be caused by a plugged or closed off discharge line. Over pressurization can severely damage the pump, other system components and can cause bodily harm. The secondary safety relief device must be installed **in-line** between the primary device and **the pump or on the opposite side of the manifold head**. This will ensure pressure relief of the system if the primary regulating device fails. Failure to install such a safety device will void the warranty on the pump.

When the high pressure system is left running with the trigger gun off, the by-pass liquid can be routed to drain or to the pump inlet. If routed to the pump inlet, the **by-pass liquid can quickly develop excessive heat and result in damage to the pump**. A THERMO VALVE installed in the by-pass line is recommended to protect the pump. An AUTO SHUT-OFF ASSEMBLY may also be used.

NOZZLES: A worn nozzle will result in loss of pressure. Do not adjust pressure regulating device to compensate. Replace nozzle and reset regulating device to system pressure.

PUMPED LIQUIDS: Some liquids may require a **flush between operations or before storing**. For pumping liquids other than water, contact your CAT PUMPS supplier.

STORING: For extended storing or between use in cold climates, drain all pumped liquids from pump and **flush with antifreeze solution to prevent freezing and damage** to the pump. **DO NOT RUN PUMP WITH FROZEN LIQUID** (refer to Tech Bulletin 083).

⚠ WARNING

All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). Failure to install such relief devices could result in personal injury or damage to the pump or to system components. CAT PUMPS does not assume any liability or responsibility for the operation of a customer's high pressure system.

Products described hereon are covered by one or more of the following U.S. patents 3558244, 3652188, 3809508, 3920356, 3930756 and 5035580

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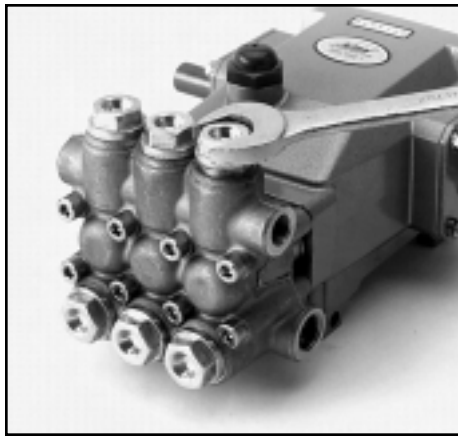
e-mail: cpi@catpumps.be www.catpumps.be

CAT PUMPS DEUTSCHLAND GmbH

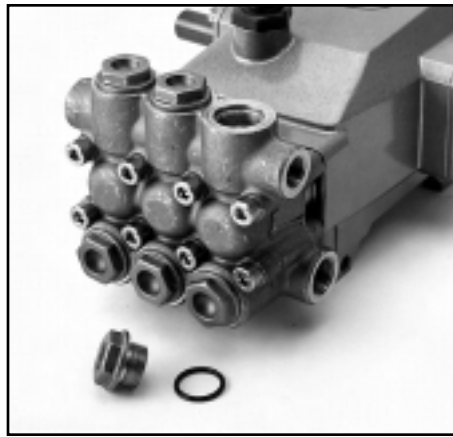
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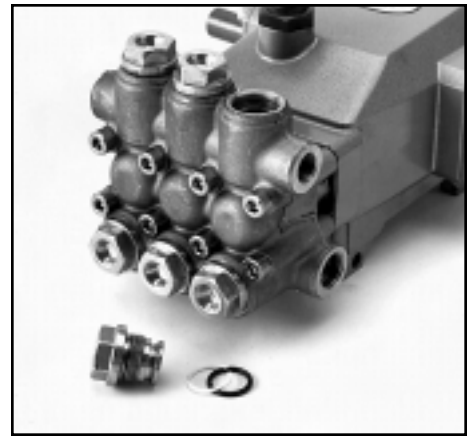
e-mail: catpumps@t-online.de www.catpumps.de



All Models
Removal of Valve Plugs



3CP1120, 5CP2120W, 7CP6170
Valve Plug and O-Ring



5CP3120, 5CP5120, 5CP5150
Valve Plug, O-Ring and Back-up Ring

CAUTION: Before commencing with service, shut off drive (electric motor, gas or diesel engine) and turn off water supply to pump. Relieve all discharge line pressure by triggering gun or opening valve in discharge line.

After servicing is completed, turn on water supply to pump, start drive, reset pressure regulating device and secondary valve, read system pressure on the gauge at the pump head. Check for any leaks, vibration or pressure fluctuations and resume operation.

SERVICING THE VALVES

1. Remove the hex Valve Plugs (top discharge, bottom inlet).
2. Examine the O-Ring under the plug for cuts or distortion. Replace if worn. Lubricate new O-Rings before installing.

NOTE: The 5CP3120, 5CP5120 and 5CP5150 have both an O-Ring and Back-up Ring on the Valve Plug.

3. Grasp Spring Retainer by the tab at the top with a pliers and remove from each valve chamber. Usually the valve assembly will remain together while being removed. To separate the valve assembly, insert a screw-driver into the side of the Spring Retainer and press on the back side of the Valve to begin separation, then between the Spring Retainer and Seat to separate completely. If the valve assembly separates during removal, remove the Spring and Valve with a needle nose pliers. With a reverse pliers, remove the Seat from each valve chamber. Then, with a small screwdriver, carefully remove the O-Ring at the bottom of the valve chamber.

NOTE: The 5CP2120W, 5CP6120 and 7CP6170 have an O-Ring and Back-up Ring on each Seat.

4. Examine all valve parts for pitting, gouges or wear and replace with preassembled Valve Assembly. Service kit contains Spring Retainers, Springs, Valves, Seats, Back-up Rings and O-Rings.

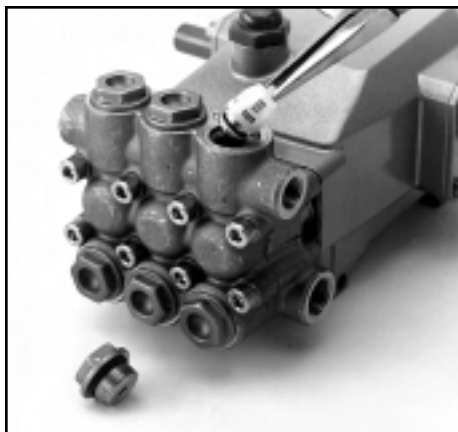
NOTE: Inlet and discharge valve parts are interchangeable. Two Valve Kits are needed for complete valve change.

5. Grasp new Valve Assembly by the tab at the top with a pliers, immerse in oil and push into each valve chamber. Be certain valve assembly is completely seated in valve chamber.

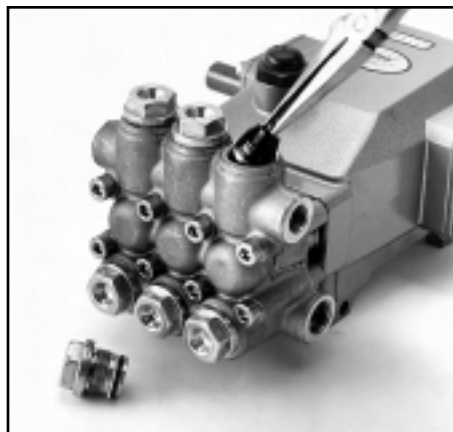
NOTE: For certain applications apply liquid gasket to the o-ring crevices and seal surfaces. See Tech Bulletin 053 for model identification.

NOTE: EPDM elastomers require Silicone-base lubricant.

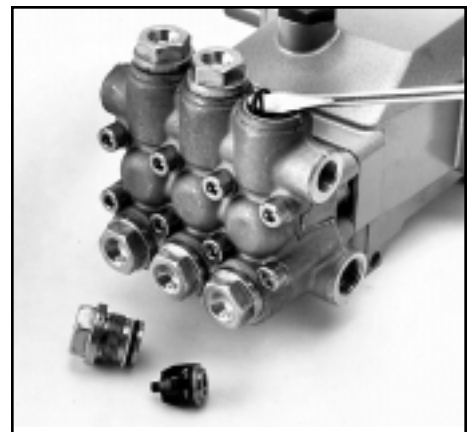
6. Apply Loctite® 242® to the threads of each Valve Plug, thread into valve port and torque per chart.



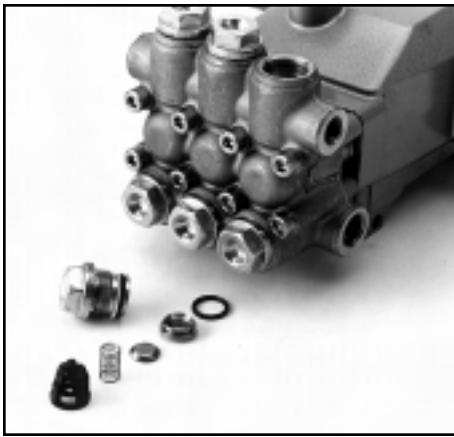
3CP1120, 5CP2120W, 7CP6170
Removal of Valve Assembly



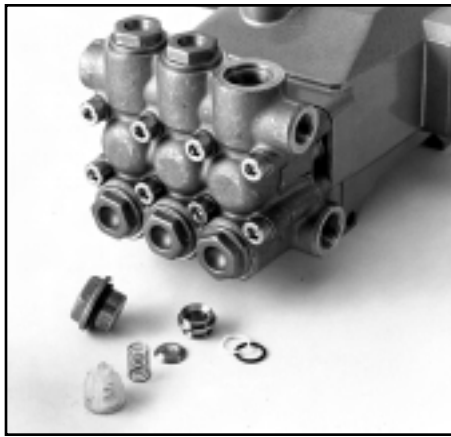
5CP3120, 5CP5120, 5CP5150
Removal of Valve Assembly



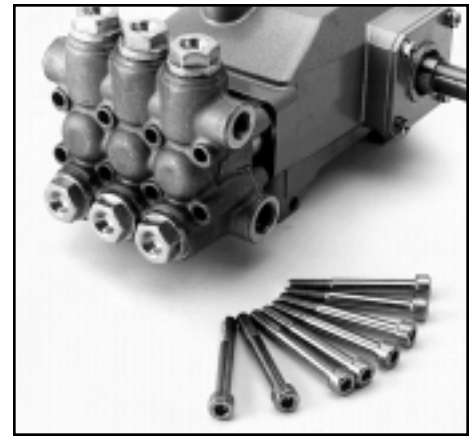
All Models
Removal of Valve Seat O-Ring



3CP1120, 5CP3120, 5CP5120
Complete Valve Assembly



5CP2120W, 5CP6120, 7CP6170
Complete Valve Assembly



All Models
Removal of Socket Head Screws

SERVICING THE PUMPING SECTION

Disassembly

1. Using an allen wrench, remove the Socket Head Screws from the Manifold Head.
2. Rotate Crankshaft by hand to start separation of Manifold Head from Crankcase.
3. Insert two flat head screwdrivers on opposite sides to further separate Manifold Head from Crankcase. Support the underside of the Manifold Head and tap lightly with a mallet on the backside of the Manifold Head.

CAUTION: KEEP MANIFOLD PROPERLY ALIGNED WITH CERAMIC PLUNGERS WHEN REMOVING TO AVOID DAMAGE TO THE PLUNGERS.

4. Remove the Seal Retainer from each plunger rod and examine for wear.
5. Examine Ceramic Plunger for cracks or scoring. Refer to **SERVICING THE PLUNGERS** if replacement is needed.

Reassembly

1. Generally Plungers do not need to be replaced. Clean plungers and remove any foreign material with a non-abrasive cleaner.
2. Install Seal Retainer over Plungers with small tab facing down and holes facing forward towards manifold head.
3. Rotate the crankshaft so the two outside plungers are extended the same distance.
4. Lightly lubricate the Plungers and carefully slide the Manifold Head onto the Plungers supporting from the underside. On the high pressure V-Packing models or larger manifolds, it may be necessary to gently tap with a soft mallet until the Manifold Head is flush with the Crankcase.
5. Replace Socket Head Screws and torque per chart.



3CP1120, 5CP2120W, 5CP6120
Seal Arrangement



5CP3120, 5CP5120, 5CP5150, 7CP6170
Seal Arrangement



All Models except 7CP6170
Plunger Arrangement

SERVICING THE PLUNGERS

Disassembly

1. To service the plungers, it is necessary to remove the manifold head. Follow disassembly procedure for **SERVICING THE PUMPING SECTION**.
2. Remove the Seal Retainer from each plunger rod.
3. Using a wrench, loosen the Plunger Retainer about three to four turns.
4. Push the Ceramic Plunger back towards the crankcase to separate from the Plunger Retainer and proceed with unthreading the Plunger Retainer by hand.
5. Remove the Plunger Retainer, Seal Washer, Ceramic Plunger, Keyhole Washer and Barrier Slinger from each Plunger Rod.
6. On the model 7CP6170 remove the Plunger Retainer, Stud, Gasket, O-Ring, Back-up Ring, Ceramic Plunger and Barrier Slinger from each Plunger Rod.
7. All other models, lubricate and install Seal Washer onto Plunger Retainer.
8. On the model 7CP6170 apply Loctite® 242® to one end of threaded Plunger Retainer Stud and secure to Plunger Retainer.
9. Examine Ceramic Plungers for scoring, scale build-up, chips or cracks and replace as needed. Generally the ceramic plungers do not need to be replaced.
10. Slide Plunger Retainer Assembly into flat end of Ceramic Plunger.
11. Apply Loctite® 242® to exposed threaded end of Plunger Retainer.
12. Install Ceramic Plunger with Plunger Retainer onto each Plunger Rod shoulder and thread Plunger Rod. Torque to specifications per chart.

NOTE: Ceramic Plungers can only be installed in one direction. Counterbore end of Ceramic Plunger to fit over Plunger Rod shoulder.

Reassembly

1. Visually inspect Crankcase Oil Seals for deterioration or leaks and contact factory for assistance with replacement.
2. Replace Barrier Slinger if damaged and slide onto Plunger Rod **with concave side away from Crankcase**.
3. Examine Seal Washer for cuts or wear and replace as needed.
4. On the model 7CP6170 examine Gaskets, O-Rings and Back-up Rings for cuts or wear and replace as needed.
5. Examine Plunger Retainers and Studs for wear or damaged threads and replace as needed.
6. On the model 7CP6170 install Gaskets first, then O-Rings and Back-up Rings onto the Plunger Retainer.
13. Install Seal Retainers with small tabs facing down and holes facing forward towards manifold head.
14. Proceed with servicing the seals or remounting of Manifold Head as described.

NOTE: Lubricate O-Rings and Back-up Rings for ease in installation and to reduce possible damage.

SERVICING THE SEALS AND V-PACKINGS

Disassembly

1. Remove the Manifold Head as described in **SERVICING THE PUMPING SECTION**.
2. Place the **Crankcase side of manifold facing up** and with a reverse pliers, remove the Lo-Pressure Seal from the Seal Case.
3. Using a reverse pliers, remove the press-in style Seal Case from the Manifold Head.
4. Remove the O-Ring from O.D. of Seal Case.

Hi-Pressure Seal

Models 3CP1120, 3CP1130, 3CP1140, 5CP2120W, 5CP2140WCS, 5CP2150W, 5CP6120, 5CP6120GI

The Hi-Pressure Seal is generally easily removed from the manifold without any tools. If extremely worn, a reverse pliers may be used.

V-Packing

Models 5CP3120, 5CP3120G1, 5CP3130G1, 5CP5120, 5CP5150G1, 7CP6170

The V-Packings and Male Adapter are easily removed from the manifold without any tools. If extremely worn, a reverse pliers may be used.

Reassembly

NOTE: If your pump has been built with special seals and O-Rings, service with same type. Refer to pump Data Sheet for correct parts or kits.

Hi-Pressure Seal Models:

1. Lubricate each seal chamber in manifold head.
NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces. See Tech Bulletin 053 for model identification.
NOTE: EPDM elastomers require silicone-base lubricant.
2. Carefully square Hi-Pressure Seal into position by hand with the **grooved side down** (metal back facing out) and press into each seal chamber until completely seated.
3. Examine Seal Case O-Rings and replace if worn. Lubricate new O-Ring before installing.
4. Press the Seal Case into each seal chamber until completely seated.

V-Packing Models:

1. Lubricate each seal chamber in manifold head.
NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces. See Tech Bulletin 053 for model identification.
NOTE: EPDM elastomers require silicone-base lubricant.
2. Insert Male Adapter **with notches down** and **“v” side up** and press completely into each seal chamber by hand.
3. Lubricate V-Packings and install one at a time with **grooved side down** into each seal chamber.
4. Examine Seal Case O-Ring and replace if worn. Lubricate new O-Rings before installing.
5. Press Seal Case into each seal chamber until completely seated.

Lo-Pressure Seal-All Models:

1. Examine Lo-Pressure Seals for wear to the internal ridges, outer surfaces or for broken springs and replace as needed.
2. Install Lo-Pressure Seal into Seal Case with **garter spring down**.
3. All Models: Install Seal Retainer over Plungers with **small tabs facing down** and **holes facing forward** towards manifold head.
4. Replace Manifold Head onto pump as described under **SERVICING THE PUMPING SECTION** and torque per chart.

SERVICING THE CRANKCASE SECTION

1. While Manifold Head, Plungers and Seal Retainers are removed, examine Crankcase Oil Seals for leaking and wear.
2. Check for any signs of leaking at Rear Cover, Drain Plug, Bubble Gauge and Dipstick (7CP6170).
3. Check oil level and for evidence of water in oil. Change crankcase oil on a regular schedule. See Preventative Maintenance Check-List.
4. Rotate Crankshaft by hand to feel for smooth bearing movement.
5. Examine Crankshaft Oil Seal externally for drying, cracking or leaking.
6. Contact CAT PUMPS or your local distributor if crankcase service is evidenced.

PREVENTATIVE MAINTENANCE CHECK-LIST						
Check	Daily	Weekly	50 hrs.	500 hrs.*	1500 hrs.**	3000 hrs.**
Clean Filters	x					
Oil Level/Quality	x					
Oil Leaks	x					
Water Leaks	x					
Belts, Pulley		x				
Plumbing		x				
Initial Oil Change			x			
Oil Change				x		
Seal Change					x	
Valve Change						x
Accessories					x	
* If other than CAT PUMPS special cutstom-blend multi-viscosity ISO68 hydraulic oil is used, change cycle should be every 300 hours. ** Each system's maintenance cycle will be exclusive. If system performance decreases, check immediately. If no wear at 1500 hours, check again at 2000 hours and each 500 hours until wear is observed. Valves typically require changing every other seal change. Duty cycle, temperature, quality of pumped liquid and inlet feed conditions all effect the life of pump wear parts and service cycle. ** Remember to service the regulator/unloader at each seal servicing and check all system accessories and connections before resuming operation. Refer to service DVD for additional assistance.						

TORQUE CHART						
Pump Item Pump Model	Thread	Tool Size [P/N]	Torque in.lbs. ft.lbs. Nm			
Plunger Retainer	M6	M10 Hex [25082]	55	4.6	6.2	
Manifold Screw	M8	M6 Allen [30941]	115	9.58	13	
Valve Plugs						
3CP, 5CP	M22	M24 Hex [44046]	870	72.5	98	
7CP	M26	M27 Hex [44045]	870	72.5	98	
Bearing Cover Screws						
3CP	M6	M10 Hex./Phil. [25082]	50	4.0	5.4	
5CP, 7CP	M8	M13 Hex [25324]	115	9.58	13	
Rear Cover Screws	M6	M10 Hex./Phil. [25082]	50	4.0	5.4	
Connecting Rod Screws	M7	M10 Hex [25082}	95	8.0	11	
Bubble Oil Gauge	M28	Oil Gauge Tool [44050]	45	3.8	5	
Direct Mount Bolts	M8	M13 Hex [25324]	115	9.58	13	

TECHNICAL BULLETIN REFERENCE CHART		
No.	Subject	Models
002	Inlet Pressure VS Liquid Temperature	All Models
003	Power Unit Drive Packages	3PFR - 68PFR, 10FR - 60FR
024	Lubrication of Lo-Pressure Seals	All Models
036	Cylinder and Plunger Reference Chart	All Models
043	LPS and HPS Servicing	All Plunger Models
060	Baffle Assembly	34170
064	By-Pass Hose Sizing	All Unloaders/Regulators
074	Torque Chart	Piston and Plunger Pumps
077	Oil Drain Kit	All Models (except 2SF/4SF)
078	Field Retrofit Mounting	5CP
083	Winterizing a Pump	All Models

INLET CONDITION CHECK-LIST

Review Before Start-Up

Inadequate inlet conditions can cause serious malfunctions in the best designed pump. Surprisingly, the simplest of things can cause the most severe problems or go unnoticed to the unfamiliar or untrained eye. REVIEW THIS CHECK-LIST BEFORE OPERATION OF ANY SYSTEM. Remember, no two systems are alike, so there can be no **ONE** best way to set-up a system. All factors must be carefully considered.

INLET SUPPLY should exceed the maximum flow being delivered by the pump to assure proper performance.

- ☐ Open inlet shut-off valve and turn on water supply to avoid starving pump. **DO NOT RUN PUMP DRY.**
- ☐ Temperatures above 130°F are permissible. Add 1/2 PSI inlet pressure per each degree F over 130°F. Elastomer or RPM changes may be required. See Tech Bulletin 002 or call CAT PUMPS for recommendations.
- ☐ Avoid closed loop systems especially with high temperature, ultra-high pressure or large volumes. Conditions vary with regulating/unloader valve.
- ☐ Low vapor pressure liquids, such as solvents, require a booster pump and C.A.T. to maintain adequate inlet supply.
- ☐ Higher viscosity liquids require a positive head and a C.A.T. to assure adequate inlet supply.
- ☐ Higher temperature liquids tend to vaporize and require positive heads and C.A.T. to assure adequate inlet supply.
- ☐ When using an inlet supply reservoir, size it to provide adequate liquid to accommodate the maximum output of the pump, generally a minimum of 6-10 times the GPM (however, a combination of system factors can change this requirement); provide adequate baffling in the tank to eliminate air bubbles and turbulence; install diffusers on all return lines to the tank.

INLET LINE SIZE should be adequate to avoid starving the pump.

- ☐ Line size must be a minimum of one size larger than the pump inlet fitting. Avoid tees, 90 degree elbows or valves in the inlet line of the pump to reduce the risk of flow restriction and cavitation.
- ☐ The line **MUST** be a FLEXIBLE hose, NOT a rigid pipe, and reinforced on SUCTION systems to avoid collapsing.
- ☐ The simpler the inlet plumbing the less the potential for problems. Keep the length to a minimum, the number of elbows and joints to a minimum (ideally no elbows) and the inlet accessories to a minimum.
- ☐ Use pipe sealant to assure air-tight, positive sealing pipe joints.

INLET PRESSURE should fall within the specifications of the pump.

- ☐ Acceleration loss of liquids may be increased by high RPM, high temperatures, low vapor pressures or high viscosity and may require pressurized inlet and C.A.T. to maintain adequate inlet supply. **DO NOT USE C.A.T. WITH SUCTION INLET.**
- ☐ Optimum pump performance is obtained with +20 PSI (1.4 BAR) inlet pressure and a C.A.T. for certain applications. With adequate inlet plumbing, most pumps will perform with flooded suction. Maximum inlet pressure is 60 PSI (4 BAR).
- ☐ After prolonged storage, pump should be rotated by hand and purged of air to facilitate priming. Disconnect the discharge port and allow liquid to pass through pump and measure flow.

INLET ACCESSORIES are offered to protect against over pressurization, contamination or temperature and control flow.

- ☐ A shut-off valve is recommended to facilitate maintenance.
- ☐ Installation of a C.A.T. is essential in applications with stressful conditions such as high temperatures, booster pump feed or long inlet lines. **Do not use C.A.T. with negative inlet pressure.**
- ☐ A stand pipe can be used in some applications to help maintain a positive head at the pump inlet line.
- ☐ Inspect and clean inlet filters on a regular schedule to avoid flow restriction.
- ☐ A pressure transducer is necessary to accurately read inlet pressure. **Short term, intermittent cavitation will not register on a standard gauge.**
- ☐ All accessories should be sized to avoid restricting the inlet flow.
- ☐ All accessories should be compatible with the solution being pumped to prevent premature failure or malfunction.
- ☐ Optional inlet protection can be achieved by installing a pressure cut off switch between the inlet filter and the pump to shut off pump when there is no positive inlet pressure.

BY-PASS TO INLET Care should be exercised when deciding the method of by-pass from control valves.

- ☐ It is recommended the by-pass be directed to a baffled reservoir tank, with at least one baffle between the by-pass line and the inlet line to the pump.
- ☐ Although not recommended, by-pass liquid may be returned to the inlet line of the pump if the system is properly designed to protect your pump. When a pulsation dampener is used, a PRESSURE REDUCING VALVE must be installed on the inlet line (**BETWEEN** THE BY-PASS CONNECTION AND THE INLET TO THE PUMP) to avoid excessive pressure to the inlet of the pump. It is also recommended that a THERMO VALVE be used in the by-pass line to monitor the temperature build-up in the by-pass loop to avoid premature seal failure.
- ☐ A reinforced, flexible, low pressure hose rated up to 300 PSI should be used for routing by-pass back to the pump inlet.
- ☐ Caution should be exercised not to undersize the by-pass hose diameter and length. Refer to Technical Bulletin 064 for additional information on the size and length of the by-pass line.
- ☐ Check the pressure in the by-pass line to avoid over pressurizing the inlet.
- ☐ The by-pass line should be connected to the pump inlet line at a gentle angle of 45° or less and no closer than 10 times the pump inlet port diameter e.g. 1-1/2" port size = 15" distance from pump inlet port.

HOSE FRICTION LOSS

Water* Flow Gal/Min	PRESSURE DROP IN PSI PER 100 FT OF HOSE WITH TYPICAL WATER FLOW RATES Hose Inside Diameters, Inches						
	1/4	5/16	3/8	1/2	5/8	3/4	1"
0.5	16	5	2				
1	54	20	7	2			
2	180	60	25	6	2		
3	380	120	50	13	4	2	
4		220	90	24	7	3	
5		320	130	34	10	4	
6			220	52	16	7	1
8			300	80	25	10	2
10			450	120	38	14	3
15			900	250	80	30	7
20			1600	400	121	50	12
25				650	200	76	19
30					250	96	24
40					410	162	42
50					600	235	62
60						370	93

*At a fixed flow rate with a given size hose, the pressure drop across a given hose length will be directly proportional. A 50 ft. hose will exhibit one-half the pressure drop of a 100 ft. hose. Above values shown are valid at all pressure levels.

WATER LINE PRESSURE LOSS PRESSURE DROP IN PSI PER 100 FEET

Water GPM	Steel Pipe—Nominal Dia.						Brass Pipe—Nominal Dia.						Copper Tubing O.D. Type L						
	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	1/4	3/8	1/2	5/8	3/4
1	8.5 1.9						6.0 1.6						120 13 2.9 1.0						
2	30 7.0 2.1						20 5.6 1.8						400 45 10 3.4 1.3						
3	60 14 4.5 1.1						40 11 3.6						94 20 6.7 2.6						
5	150 36 12 2.8						100 28 9.0 2.2						230 50 17 6.1 3.0						
8	330 86 28 6.7 1.9						220 62 21 5.2 1.6						500 120 40 15 6.5						
10	520 130 43 10 3.0						320 90 30 7.8 2.4						180 56 22 10						
15	270 90 21 6.2 1.6						190 62 16 5.0 1.5						120 44 20						
25	670 240 56 16 4.2 2.0						470 150 40 12 3.8 1.7						330 110 50						
40	66 17 8.0						39 11 5.0						550 200 88						
60	37 17						23 11												
80	52 29						40 19												
100	210 107 48						61 28												

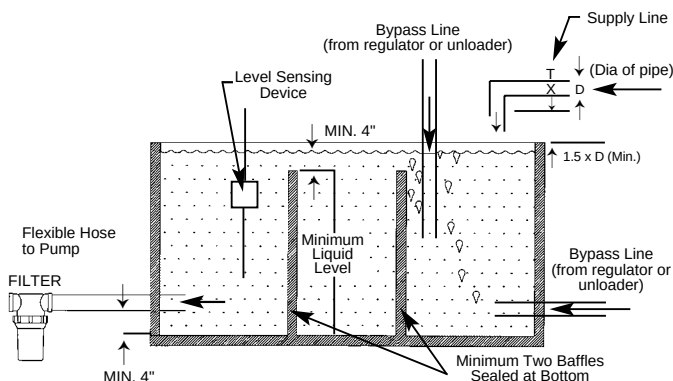
RESISTANCE OF VALVES AND FITTINGS

Nominal Pipe Size Inches	Inside Diameter Inches	Equivalent Length of Standard Pipe in Feet							
		Gate Valve	Globe Valve	Angle Valve	45° Elbow	90° Elbow	180° Close Ret	Tee Thru Run	Tee Thru Branch
1/2	0.622	0.41	18.5	9.3	0.78	1.67	3.71	0.93	3.33
3/4	0.824	0.54	24.5	12.3	1.03	2.21	4.90	1.23	4.41
1	1.049	0.69	31.2	15.6	1.31	2.81	6.25	1.56	5.62
1¼	1.380	0.90	41.0	20.5	1.73	3.70	8.22	2.06	7.40
1½	1.610	1.05	48.0	24.0	2.15	4.31	9.59	2.40	8.63
2	2.067	1.35	61.5	30.8	2.59	5.55	12.30	3.08	11.60
2½	2.469	1.62	73.5	36.8	3.09	6.61	14.70	3.68	13.20
3	3.068	2.01	91.5	45.8	3.84	8.23	18.20	4.57	16.40
4	4.026	2.64	120.0	60.0	5.03	10.80	23.90	6.00	21.60

Arriving at a total line pressure loss, consideration should then be given to pressure loss created by valves, fittings and elevation of lines.

If a sufficient number of valves and fittings are incorporated in the system to materially affect the total line loss, add to the total line length, the equivalent length of line of each valve or fitting.

TYPICAL RESERVOIR TANK RECOMMENDED 6 TO 10 TIMES SYSTEM CAPACITY



Handy Formulas to Help You

Q. How can I find the RPM needed to get specific GPM (Gallons Per Minute) I want?

$$A. \text{Desired RPM} = \text{Desired GPM} \times \frac{\text{Rated RPM}}{\text{Rated GPM}}$$

Q. I have to run my pump at a certain RPM. How do I figure the GPM I'll get?

$$A. \text{Desired GPM} = \text{Desired RPM} \times \frac{\text{Rated GPM}}{\text{Rated RPM}}$$

Q. Is there a simple way to find the approximate horsepower I'll need to run the pump?

$$A. \text{Electric Brake Horsepower Required} = \frac{\text{GPM} \times \text{PSI}}{1460} \quad (\text{Standard 85\% Mech. Efficiency})$$

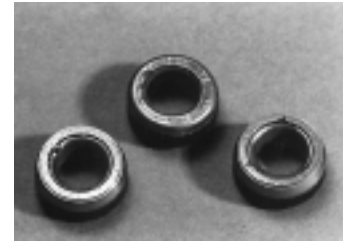
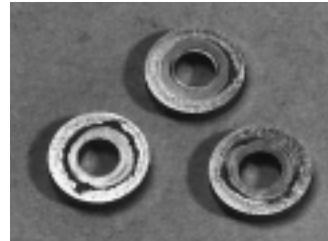
Q. What size motor pulley should I use?

$$A. \text{Pump Pulley (Outer Diameter)} \times \frac{\text{Pump RPM}}{\text{Motor/Engine RPM}} \quad (\text{Consult Engine Mfr.})$$

Q. How do I calculate the torque for my hydraulic drive system?

$$A. \text{Torque (ft. lbs.)} = 3.6 \left(\frac{\text{GPM} \times \text{PSI}}{\text{RPM}} \right)$$

Avoid Cavitation Damage



One or several of the conditions shown in the chart below may contribute to cavitation in a system resulting in premature wear, system downtime and unnecessary operating costs.

CONDITION	SOLUTION
Inadequate inlet line size	• Increase line size to the inlet port or one size larger
Water hammering liquid acceleration/deacceleration	• Install C.A.T. Tube • Move pump closer to liquid supply
Rigid Inlet Plumbing	• Use flexible wire reinforced hose to absorb pulsation and pressure spikes
Excessive Elbows in Inlet Plumbing	• Keep elbows to a minimum and less than 90°
Excessive Liquid Temperature	• Use Thermo Valve in bypass line • Do not exceed pump temperature specifications • Substitute closed loop with baffled holding tank • Adequately size tank for frequent or high volume bypass • Pressure feed high temperature liquids • Properly ventilate cabinets and rooms
Air Leaks in Plumbing	• Check all connections • Use PTFE thread tape or pipe thread sealant
Agitation in Supply Tank	• Size tank according to pump output — Minimum 6-10 times system GPM • Baffle tank to purge air from liquid and separate inlet from discharge
High Viscosity Liquids	• Verify viscosity against pump specifications before operation • Elevate liquid temperature enough to reduce viscosity • Lower RPM of pump • Pressure feed pump • Increase inlet line size
Clogged Filters	• Perform regular maintenance or use clean filters to monitor build up • Use adequate mesh size for liquid and pump specifications

DIAGNOSIS AND MAINTENANCE

One of the most important steps in a high pressure system is to establish a regular maintenance program. This will vary slightly with each system and is determined by various elements such as the duty cycle, the liquid being pumped, the actual specifications vs rated specifications of the pump, the ambient conditions, the inlet conditions and the accessories in the system. A careful review of the necessary inlet conditions and protection devices required before the system is installed will eliminate many potential problems.

CAT PUMPS are very easy pumps to service and require far less frequent service than most pumps. Typically, only common tools are required, making in-field service convenient, however, there are a few custom tools, special to certain models, that do simplify the process. This service manual is designed to assist you with the disassembly and reassembly of your pump. The following guide will assist in determining the cause and remedy to various operating conditions. You can also review our **FAQ** or **SERVICE** sections on our **WEB SITE** for more facts or contact CAT PUMPS directly.

PROBLEM	PROBABLE CAUSE	SOLUTION
Low pressure	•Worn nozzle. •Belt slippage. •Air leak in inlet plumbing. •Pressure gauge inoperative or not registering accurately. •Relief valve stuck, partially plugged or improperly adjusted. •Inlet suction strainer (filter) clogged or improperly sized. •Abrasives in pumped liquid. •Leaky discharge hose. •Inadequate liquid supply. •Severe cavitation. •Worn seals. •Worn or dirty inlet/discharge valves.	•Replace with properly sized nozzle. •Tighten belt(s) or install new belt(s). •Tighten fittings and hoses. Use PTFE liquid or tape. •Check with new gauge. Replace worn or damaged gauge. •Clean/adjust relief valve. Replace worn seats/valves and o-rings. •Clean filter. Use adequate size filter. Check more frequently. •Install proper filter. •Replace discharge hose with proper rating for system. •Pressurize inlet and install C.A.T. •Check inlet conditions. •Install new seal kit. Increase frequency of service. •Clean inlet/discharge valves or install new valve kit.
Pulsation	•Faulty Pulsation Dampener. •Foreign material trapped in inlet/discharge valves.	•Check precharge. If low, recharge, or install a new dampener. •Clean inlet/discharge valves or install new valve kit.
Water leak		
•Under the manifold	•Worn V-Packings, Hi-Pressure or Lo-Pressure Seals. •Worn adapter o-rings.	•Install new seal kit. Increase frequency of service. •Install new o-rings.
•Into the crankcase	•Humid air condensing into water inside the crankcase. •Excessive wear to seals and V-Packings.	•Install oil cap protector. Change oil every 3 months or 500 hours. •Install new seal kit. Increase frequency of service.
Knocking noise		
•Inlet supply	•Inadequate inlet liquid supply.	•Check liquid supply. Increase line size, pressurize or install C.A.T.
•Bearing	•Broken or worn bearing.	•Replace bearing.
•Pulley	•Loose pulley on crankshaft	•Check key and tighten set screw.
Oil leak		
•Crankcase oil seals.	•Worn crankcase oil seals.	•Replace crankcase oil seals.
•Crankshaft oil seals and o-rings.	•Worn crankshaft oil seals or o-rings on bearing cover.	•Remove bearing cover and replace o-rings and/or oil seals.
•Drain plug	•Loose drain plug or worn drain plug o-ring.	•Tighten drain plug or replace o-ring.
•Bubble gauge	•Loose bubble gauge or worn bubble gauge gasket.	•Tighten bubble gauge or replace gasket.
•Rear cover	•Loose rear cover or worn rear cover o-ring.	•Tighten rear cover or replace o-ring.
•Filler cap	•Loose filler cap or excessive oil in crankcase.	•Tighten filler cap. Fill crankcase to specified capacity.
Pump runs extremely rough		
•Inlet conditions	•Restricted inlet or air entering the inlet plumbing	•Correct inlet size plumbing. Check for air tight seal.
•Pump valves	•Stuck inlet/discharge valves.	•Clean out foreign material or install new valve kit.
•Pump seals	•Leaking V-Packings, Hi-Pressure or Lo-Pressure seals.	•Install new seal kit. Increase frequency of service.
Premature seal failure	•Scored plungers. •Over pressure to inlet manifold. •Abrasive material in the liquid being pumped. •Excessive pressure and/or temperature of pumped liquid. •Running pump dry. •Starving pump of adequate liquid. •Eroded manifold.	•Replace plungers. •Reduce inlet pressure per specifications. •Install proper filtration at pump inlet and clean regularly. •Check pressure and inlet liquid temperature. •DO NOT RUN PUMP WITHOUT LIQUID. •Increase hose one size larger than inlet port size. Pressurize and install C.A.T. •Replace manifold. Check liquid compatibility.



FEATURES

Superior Design

- Triplex plunger design gives smoother liquid flow.
- Hi-Pressure Seals or V-Packings are completely lubricated and cooled by the liquid being pumped.
- Inlet and discharge valve assemblies interchange for easier maintenance.
- Lubricated Lo-Pressure Seals provide double protection against external leakage.
- Oil bath crankcase assures optimum lubrication.
- Close tolerance concentricity of the ceramic plunger maximizes seal life.

Quality Materials

- Precision design 304 stainless steel valves and seats are hardened and polished for ultimate seating and extended valve life.
- Forged brass manifold is strong and corrosion resistant.
- Special concentric, high-density, polished, solid ceramic plungers provide a true wear surface and extended seal life.
- Specially formulated, CAT PUMP exclusive, Hi-Pressure Seals or V-Packings offer unmatched performance and seal life.
- Die cast aluminum crankcase provides high strength, minimum weight and precision tolerance control.
- Chrome-moly crankshaft gives unmatched strength and surface hardness.
- Oversized crankshaft bearings with greater capacity mean longer bearing life.

Easy Maintenance

- Wet end is easily serviced without entering crankcase, requiring less time and effort.
- Valve assemblies are accessible without disturbing piping, for quick service.
- Preset packings mean no packing gland adjustment is necessary, reducing maintenance costs.

⚠ WARNING

All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). Failure to install such relief devices could result in personal injury or damage to the pump or to system components. CAT PUMPS does not assume any liability or responsibility for the operation of a customer's high pressure system.

7 Frame Plunger Pump

Models

530
550

SPECIFICATIONS

U.S. Measure

Metric Measure

MODEL 530

Flow	5.0 GPM	(19 L/M)
Pressure Range	100 to 2500 PSI	(7 to 175 BAR)
RPM	1100 RPM	(1100 RPM)
Bore	0.708"	(18 mm)
Stroke	0.945"	(24 mm)

MODEL 550

Flow	5.0 GPM	(19 L/M)
Pressure Range	100 to 3000 PSI	(7 to 210 BAR)
RPM	1415 RPM	(1415 RPM)
Bore	0.630"	(16 mm)
Stroke	0.945"	(24 mm)

COMMON SPECIFICATIONS

Inlet Pressure Range	Flooded to 60 PSI	(Flooded to 4 BAR)
Crankcase Capacity	25 oz.	(0.75 L)
Maximum Liquid Temperature	160°F	(71°C)
For temperatures above 130°F call CAT PUMPS for inlet conditions and elastomer recommendations.		
Inlet Ports (2)	1/2" NPTF	(1/2" NPTF)
Discharge Ports (2)	3/8" NPTF	(3/8" NPTF)
Shaft Diameter	0.945"	(24 mm)
Weight	25.5 lbs.	(11.5 kg)
Dimensions	13.6 x 9.61 x 6.41"	(346 x 244 x 163 mm)

ELECTRIC HORSEPOWER REQUIREMENTS

MODEL	FLOW		PRESSURE				MOTOR PULLEY SIZE	
			PSI 1800	PSI 2150	PSI 2500	PSI 3000	Using 1725 RPM Motor & Std. 10" Pulley O.D.	
	U.S. GPM	L/M	BAR 125	BAR 150	BAR 175	BAR 210	RPM	Pulley O.D.
530	5.0	19.0	6.2	7.4	8.6	N/A	1100	6.3
	4.5	17.0	5.6	6.6	7.7	N/A	990	5.6
	4.0	15.0	5.0	5.9	6.9	N/A	880	5.0
550	5.0	19.0	6.2	7.4	8.6	10.3	1415	8.0
	4.0	15.0	5.0	5.9	6.9	8.3	1130	6.4
	3.0	11.4	3.7	4.4	5.2	6.2	850	5.0

DETERMINING THE PUMP R.P.M.	Rated G.P.M.	=	"Desired" G.P.M.
	Rated R.P.M.	=	"Desired" R.P.M.
DETERMINING THE REQUIRED H.P.	GPM x PSI	=	Electric Brake
	1460	=	H. P. Required
DETERMINING MOTOR PULLEY SIZE	Motor Pulley O.D.	=	Pump Pulley O.D.
	Pump R.P.M.	=	Motor R.P.M.

See complete Drive Packages [Incls: Pulleys, Belts, Hubs, Key] Tech Bulletin 003.
Refer to pump **Service Manual** for repair procedure, additional technical information and **pump warranty**.

"Customer confidence is our greatest asset"

PARTS LIST

ITEM	PART NUMBER		DESCRIPTION		QTY
	530	MATL	550	MATL	
2	30067	STL	30067	STL	1
5	92519	STZP	92519	STZP	8
8	43223	AL	43223	AL	2
9	815280	FBR	815280	FBR	1
10	12393	NBR	12393	NBR	2
11	43222	NBR	43222	NBR	2
15	43221	STL	43221	STL	2
20	48863	TNM	48863	TNM	3
25	43220	FCM	43220	FCM	1
31	828710	—	828710	—	1
32	43211	ABS	43211	ABS	1
33	14177	NBR	14177	NBR	1
37	92241	—	92241	—	1
38	44428	NBR	44428	NBR	1
40	92520	STZP	92520	STZP	4
48	25625	STCP	25625	STCP	1
49	23170	NBR	23170	NBR	1
50	43217	AL	43217	AL	1
51	44836	NBR	44836	NBR	1
53	45056	AL	45056	AL	1
56	43240	POP	43240	POP	1
64	43237	CM	43237	CM	3
65	43229	ZZCP	43229	ZZCP	3
69	43227	STZP	43227	STZP	3
70	43228	NBR	43228	NBR	3
75	43328	S	43328	S	3
88	45697	S	45697	S	3
90	43232	CC	43311	CC	3
96	43235	PTFE	43235	PTFE	3
97	17399	NBR	17399	NBR	3
	14160	FPM	14160	FPM	3
98	45891	CU	45891	CU	3
99	104360	S	104360	S	3
100	45686	PVDF	45686	PVDF	3
	45687	PVDF	45687	PVDF	3
101	43239	—	43313	—	3
106	43243	NBR	43316	NBR	3
	44926	FPM	—	—	3
	—	—	106660	FPM	3
120	45683	BB	45684	BB	3
121	20285	NBR	20285	NBR	3
	11693	FPM	11693	FPM	3
125	43245	SNG	—	—	3
	44925	FPM	—	—	3
126	—	—	43320	BB	3
127	—	—	43319	PTFE	6
	—	—	46287	HT	6
128	—	—	43318	BB	3
139	22179	BBCP	22179	BBCP	1
162	43248	PTFE	43248	PTFE	6
163	43249	NBR	43249	NBR	6
	44383	FPM	44383	FPM	6
164	43722	S	43722	S	6
	43825	S	—	—	6
166	43721	S	43721	S	6
	43824	S	—	—	6
167	43751	S	43751	S	6
	43823	S	—	—	6
168	44564	PVDF	44564	PVDF	6
172	17617	NBR	17617	NBR	6
	11691	FPM	11691	FPM	6
174	43851	BBCP	43851	BBCP	6
185	45417	BBCP	45547	BBCP	1
187	46868	S	46868	S	4
194	45550	STZP	45550	STZP	4
196	43633	BB	43633	BB	1
250	43256	STCP	43256	STCP	1
255	30243	STZP	30243	STZP	1
260	30645	STZP	30645	STZP	1
	30611	STZP	30611	STZP	1
265	30660	—	30660	—	1
269	30206	F	30206	F	1
274	33000	STL	33000	STL	1
283	34334	—	34334	—	1
298	34628	STZP	34628	STZP	1
	34630	STZP	34630	STZP	1
	34959	STZP	34959	STZP	1
299	812183	BBCP	812184	BBCP	1
300	30488	NBR	30610	NBR	1
	—	—	31610	HT	1
310	30820	NBR	30820	NBR	2
	31820	NBR	31820	NBR	2
350	30696	STZP	30696	STZP	1
351	43257	STZP	43257	STZP	1
352	44050	STZP	44050	STZP	1
—	6575	—	6575	—	1
—	6107	—	6107	—	1
			Key (M8x7.5x25)		1
			Screw, HHC Sems (M6x16)		8
			Cover, Bearing		2
			Shim, Bearing Cover (2-pc)		1
			O-Ring, Bearing Cover		2
			Seal, Oil		2
			Bearing, Roller		2
			Rod, Assy, Connecting [6/02]		3
			Crankshaft, Dual End		1
			Protector, Oil Cap w/Gasket		1
			Cap, Oil Filler		1
			O-Ring, Filler Cap - 70D		1
			Gauge, Oil, Bubble w/Gasket - 80D		1
			Gasket, Flat, Oil Gauge - 80D		1
			Screw, HHC Sems (M6x20)		4
			Plug, Drain (1/4"x19BSP)		1
			O-Ring, Drain Plug - 70D		1
			Cover, Rear		1
			O-Ring, Rear Cover - 70D		1
			Crankcase (M10)		1
			Pan, Oil		1
			Pin, Crosshead		3
			Rod, Plunger		3
			Washer, Oil Seal		3
			Seal, Oil, Crankcase		3
			Slinger, Barrier		3
			Washer, Keyhole (M18)		3
			Plunger (M18x77 and M16x77)		3
			Back-up-Ring, Plunger Retainer		3
			O-Ring, Plunger Retainer - 80D		3
			O-Ring, Plunger Retainer - 70D		3
			Gasket, Plunger Retainer		3
			Retainer, Plunger w/Stud		3
			Retainer, Seal, Rear		3
			Retainer, Seal, Adapter, Front		3
			Wick, Long Tab		3
			Seal, LPS w/S-Spg		3
			Seal, LPS w/SS-Spg		3
			Seal, LPS w/S-Spg		3
			Case, Seal		3
			O-Ring, Seal Case - 70D		3
			O-Ring, Seal Case		3
			Seal, HPS w/S		3
			Seal, HPS w/SS		3
			Adapter, Female		3
			V-Packing		6
			V-Packing		6
			Adapter, Male		3
			Plug (1/2" NPT)		1
			Back-up-Ring, Seat		6
			O-Ring, Seat - 80D		6
			O-Ring, Seat - 70D		6
			Seat, Q.V.		6
			Seat, F.V.		6
			Valve, Q.V.		6
			Valve, F.V.		6
			Spring, Q.V.		6
			Spring, F.V.		6
			Retainer, Spring		6
			O-Ring, Valve Plug - 90D		6
			O-Ring, Valve Plug - 90D		6
			Plug, Valve		6
			Head, Manifold (M10F)		1
			Stud, Manifold (M10x35)		4
			Nut, Flanged (M10)		4
			Plug, Discharge (3/8" NPT)		1
			Protector, Shaft		1
			Kit, Direct Mounting		1
			Rail, Angle, Assy A-U.S. (Incls: 30635 [2.09"], 31129, 990777, 30910, 30920)		1
			Rail, Angle, Assy B-U.S. (Incls: 28499 [2.95"], 30900, 30910, 30920)		1
			Kit, Mounting (Incls: 30645, 30206, 33000, 30067, 43256)		1
			Pulley (10") [See Drive Packages, Tech Bulletin 003]		1
			Hub "H", M24 (Keyway M8) [See Drive Packages, Tech Bulletin 003]		1
			Kit, Oil Drain		1
			Clutch Assy, Single Groove, 24mm, 12VDC		1
			Clutch Assy, Dual Groove, 24mm, 12VDC		1
			Clutch Assy, Eight Groove Poly L, 24mm, 12VDC		1
			Head, Complete		1
			Kit, Seal (Incls: 97, 101, 106, 121, 125 or 127)		1
			Kit, Seal, HT (Incls: 97, 101, 106, 121, 125)		1
			Kit, Valve , Q.V. (Incls: 162-164, 166, 167, 168, 172)		2
			Kit, Valve , F.V. (Incls: 162-164, 166, 167, 168, 172)		2
			Plier, Reverse		1
			Tool, Seal Case Removal		1
			Tool, Oil Gauge Removal		1
			Plunger Pump Service DVD		1
			Oil, Bottle (21 oz.) ISO 68 Multi-Viscosity Hydraulic		1
			(Fill to specified crankcase capacity prior to start-up)		1

Bold print part numbers are unique to a particular pump model. Italics are optional items. [] Date of latest production change.

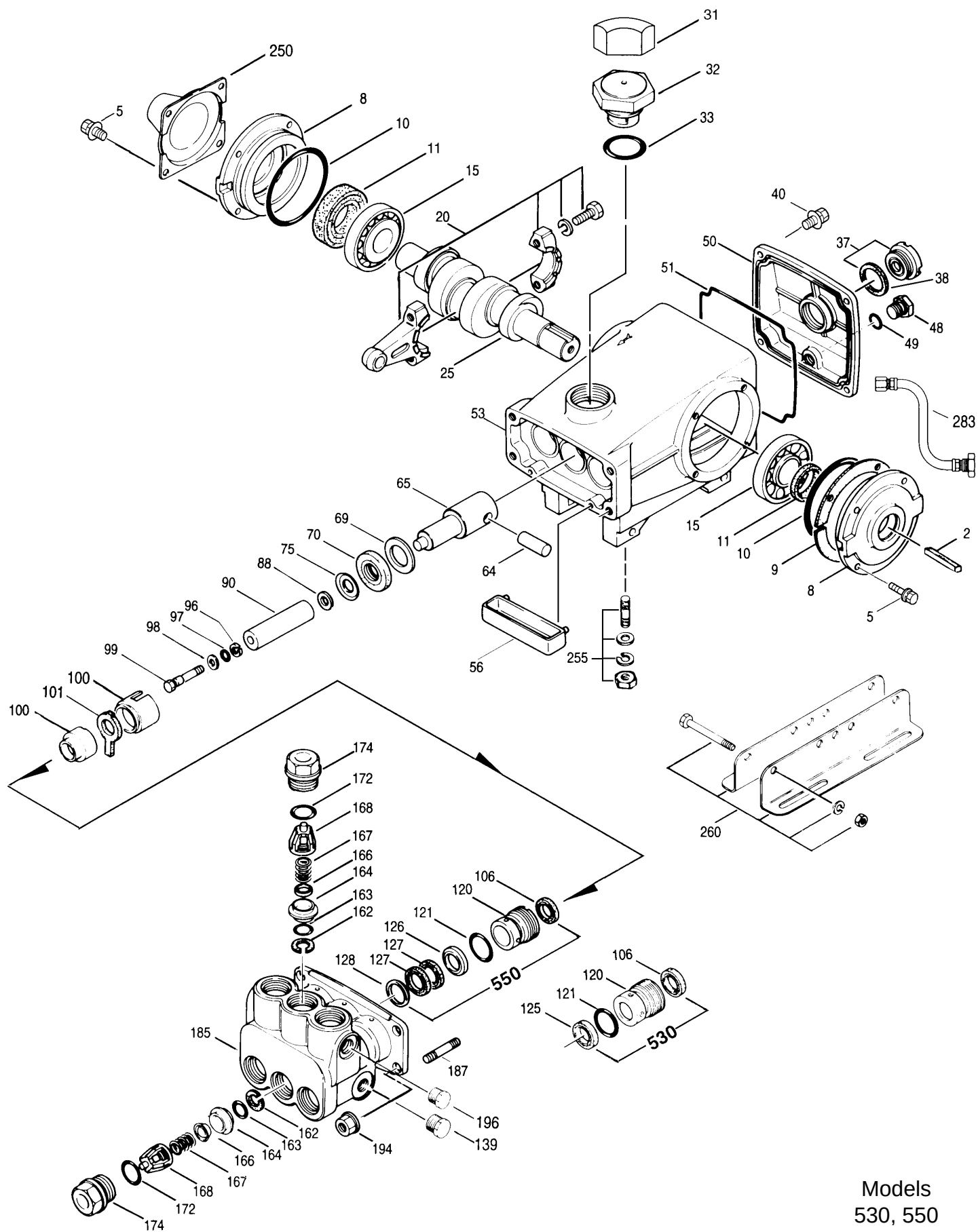
Refer to Tech Bulletins 002, 003, 008, 024, 027, 035, 036, 043, 045, 051, 053, 054, 067, 074, 077 and 083 for additional information.

MATERIAL CODES (Not Part of Part Number): AL=Aluminum ABS=ABS Plastic BB=Brass BBCP=Brass/Chrome Plated CC=Ceramic CM=Chrome-Moly

CU=Copper F=Cast Iron FBR=Fiber FCM=Forged Chrome-moly FPM=Fluorocarbon HT=Hi-Temp NBR=Medium Nitrile (Buna-N)

POP=Polypropylene PTFE=Pure Polytetrafluoroethylene PVDF=Polyvinylidene Fluoride S=304SS SNG=Special Blend (Buna) STCP=Steel/Chrome Plated STL=Steel
STZP=Steel/Zinc Plated TNM=Special High Strength ZZCP=Zamak/Chrome Plated

EXPLODED VIEW



Models
530, 550
May 2006

5, 7, 15PFR PLUNGER PUMP SERVICE MANUAL



5 FRAME: 310, 340, 350, 311, 341, 351, 317, 347, 357

5 FRAME OEM: 30, 31, 34, 35, 42HS, 43HS, 45

7 FRAME: 530, 550

7 FRAME OEM: 51, 53, 55, 56, 57, 58, 59, 60, 70

15 FRAME: 650, 651, 660, 661, 1050, 1051, 1057

INSTALLATION AND START-UP INFORMATION

Optimum performance of the pump is dependent upon the entire liquid system and will be obtained only with the proper selection, installation of plumbing and operation of the pump and accessories.

SPECIFICATIONS: Maximum specifications refer to individual attributes. It is **not** implied that **all maximums** can be performed **simultaneously**. If more than one maximum is considered, check with your CAT PUMPS supplier to confirm the proper performance and pump selection. Refer to individual pump Data Sheets for complete specifications, parts list and exploded view.

LUBRICATION: Fill crankcase with special CAT PUMP oil per pump specifications [5PFR-18 oz., 7PFR-25 oz., 15PFR-42oz.]. **DO NOT RUN PUMP WITHOUT OIL IN CRANKCASE.** Change initial fill after 50 hours running period. Thereafter, change oil every **3 months or 500 hour intervals**, whichever comes first.

PUMP ROTATION: Pump was designed for forward rotation to allow optimum lubrication of the crosshead area. Reverse rotation is acceptable if the crankcase oil level is increased slightly above center dot to assure adequate lubrication.

PULLEY SELECTION: Select size of motor pulley required to deliver the desired flow from Horsepower Requirement and Pulley Selection Chart (refer to Tech Bulletin 003 or individual Data Sheet).

DRIVE SELECTION: The motor or engine driving the pump must be of adequate horsepower to maintain full RPM when the pump is under load. Select the electric motor from the Horsepower Requirement Chart according to required pump discharge flow, maximum **pressure at the pump** and drive losses of approximately 3-5%. Consult the manufacturer of gas or diesel engine for selection of the proper engine size.

MOUNTING: Mount the pump on a rigid, horizontal surface in a manner to permit drainage of crankcase oil. An uneven mounting surface will cause extensive damage to the pump base. To minimize piping stress, **use appropriate flexible hose to inlet and discharge ports.** Use the correct belt; make sure pulleys are aligned. Excessive belt tension may be harmful to the bearings. Hand rotate pump before starting to be certain shaft and bearings are free moving.

LOCATION: If the pump is used in extremely dirty or humid conditions, it is recommended pump be enclosed. Do not store or operate in excessively high temperature areas or without proper ventilation.

INLET CONDITIONS: Refer to complete **Inlet Condition Check-List** in this manual before starting system. **DO NOT STARVE THE PUMP OR RUN DRY.** Temperatures above 130°F are permissible. Add 1/2 PSI inlet pressure per each degree F over 130°F. Elastomer or RPM changes may be required. See Tech Bulletin 002 or call CAT PUMPS for recommendations.

C.A.T.: Installation of a C.A.T. (Captive Acceleration Tube) is recommended in applications with stressful inlet conditions such as high temperatures, booster pump feed, long inlet lines or quick closing valves.

DISCHARGE CONDITIONS: OPEN ALL VALVES BEFORE STARTING SYSTEM to avoid deadhead overpressure condition and severe damage to the pump or system.

Install a **Pulsation Dampening** device on the discharge head or in the discharge line as close to the head as possible. Be certain the pulsation dampener (Prrrrr-o-lator) is properly precharged for the system pressure (see individual Data Sheet).

A **reliable Pressure Gauge** should be installed near the discharge outlet of the high pressure manifold. This is extremely important for adjusting pressure regulating devices and also for proper sizing of the nozzle or restricting orifice. The pump is rated for a maximum pressure; this is the **pressure** that is **read at the discharge manifold of the pump**, NOT AT THE GUN OR NOZZLE.

Use PTFE thread tape or pipe thread sealant (sparingly) connect accessories or plumbing. Exercise caution not to wrap tape beyond the last thread to avoid tape from becoming lodged in the pump or accessories. This condition will cause a malfunction of the pump or system.

PRESSURE REGULATION: All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). The primary pressure device must be installed on the discharge side of the pump. The function of the primary pressure regulating device is to protect the pump from over pressurization, which can be caused by a plugged or closed off discharge line. Over pressurization can severely damage the pump, other system components and can cause bodily harm. The secondary safety relief device must be installed between the primary device and pump. This will ensure pressure relief of the system if the primary regulating device fails. Failure to install such a safety device will void the warranty on the pump.

When the high pressure system is left running with the trigger gun off, the by-pass liquid can be routed to drain or to the pump inlet. If routed to the pump inlet, the **by-pass liquid can quickly develop excessive heat and result in damage to the pump.** A THERMO VALVE installed in the by-pass line is recommended to protect the pump. An AUTO SHUT-OFF ASSEMBLY may also be used.

NOZZLES: A worn nozzle will result in loss of pressure. Do not adjust pressure regulating device to compensate. Replace nozzle and reset regulating device to system pressure.

PUMPED LIQUIDS: Some Liquids may require a **flush between operations or before storing.** For pumping liquids other than water, contact your CAT PUMPS supplier.

STORING: For extended storing or between use in cold climates, drain all pumped liquids from pump and **flush with antifreeze solution to prevent freezing and damage** to the pump. **DO NOT RUN PUMP WITH FROZEN LIQUID** (refer to Tech Bulletin 083).

WARNING

All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). Failure to install such relief devices could result in personal injury or damage to the pump or to system components. CAT PUMPS does not assume any liability or responsibility for the operation of a customer's high pressure system.

Products described hereon are covered by one or more of the following U.S. patents 3558244, 3652188, 3809508, 3920356, 3930756 and 5035580

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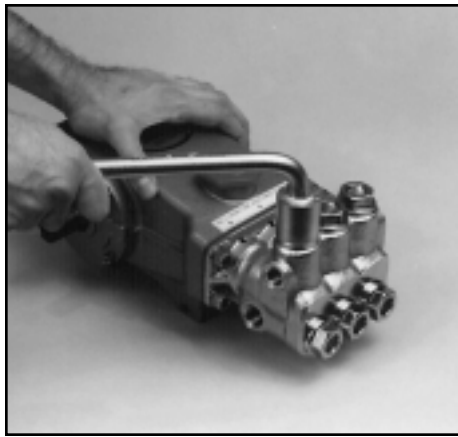
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CAT PUMPS DEUTSCHLAND GmbH

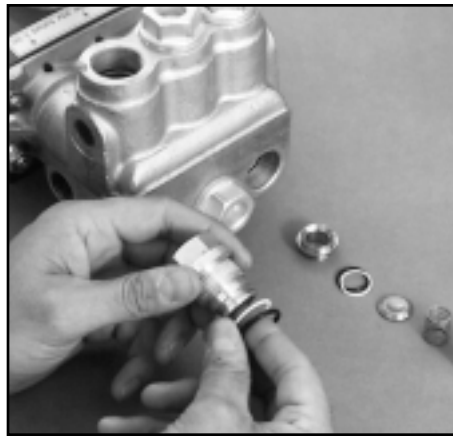
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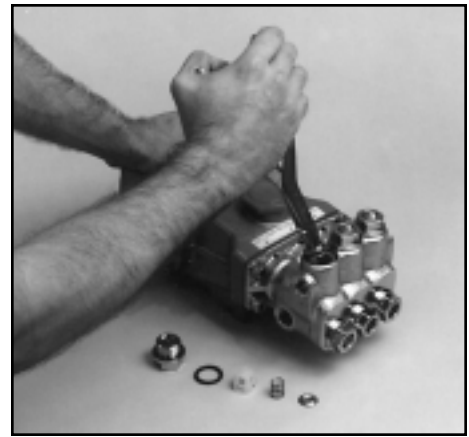
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Removal of Valve Plugs



Examination of O-Ring and Back-up-Ring on Valve Plug



Removal of Valve Assembly

CAUTION: Before commencing with service, shut off drive (electric motor, gas or diesel engine) and turn off water supply to pump. Relieve all discharge line pressure by triggering gun or opening valve in discharge line.

After servicing is completed, turn on water supply to pump, start drive, reset pressure regulating device and secondary valve, read system pressure on the gauge at the pump head. Check for any leaks, vibration or pressure fluctuations and resume operation.

SERVICING THE VALVES

Disassembly

NOTE: Usually the valve assembly will remain together while being removed.

1. Remove the hex Valve Plugs (top discharge, bottom inlet).
2. Examine the O-Ring under the Valve Plug for cuts or distortion and replace if worn. Lubricate new O-Rings before installing.

NOTE: On Models 43HS, 45, 56, 57, 59, 60, 70 there is an extended Valve Plug with O-Ring and Back-up-Ring. Install the Back-up-Ring, then the O-Ring into the groove at the end of the Valve Plug (refer to Tech Bulletin 058).

3. Grasp Spring Retainer by tab at the top with pliers and remove from valve chamber.
4. To separate the valve assembly, insert a screwdriver into the side of the Retainer and press on the back side of the Valve to begin separation, then between the Retainer and Valve Seat to separate completely.
5. If the valve assembly separates during removal, remove the Spring and Valve with a needle nose pliers.
6. Using a reverse pliers, remove the Valve Seat from the manifold chamber.

Reassembly

1. Examine Spring Retainers for internal wear or breaks in the structure and replace as needed.
2. Examine Springs for fatigue or breaks and replace as needed.
3. Examine Valves and Seats for grooves, pitting or wear and replace as needed.
4. Examine Seat and Valve Plug O-Rings for cuts or wear and replace as needed. Lubricate and install new O-Ring onto outside diameter of Seat and Valve Plugs.

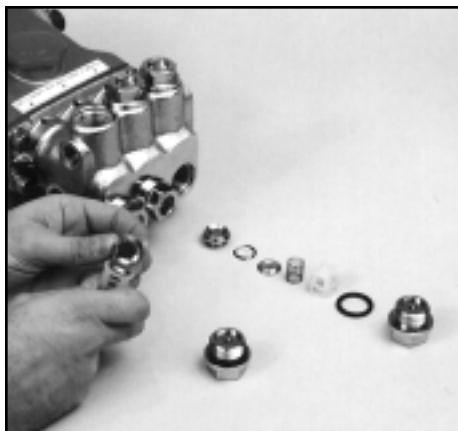
NOTE: Inlet and discharge valve parts are interchangeable. Two Valve Kits are needed for complete valve change.

5. Grasp new Valve Assembly by tab at top with pliers and push into valve chamber. Be certain Valve Assembly is completely seated in valve chamber.

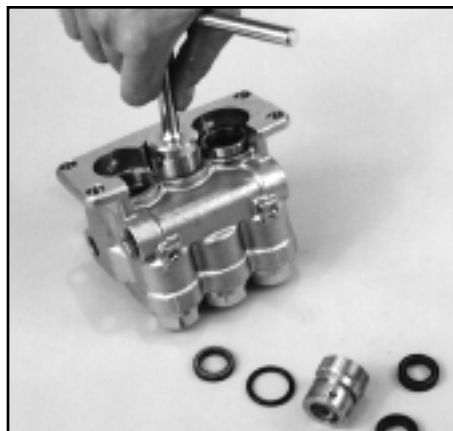
NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces (refer to Tech Bulletin 053).

NOTE: For Corrosion Resistant Models remember to install the Coil Spring between the Valve Plug and Retainer (refer to Tech Bulletin 046).

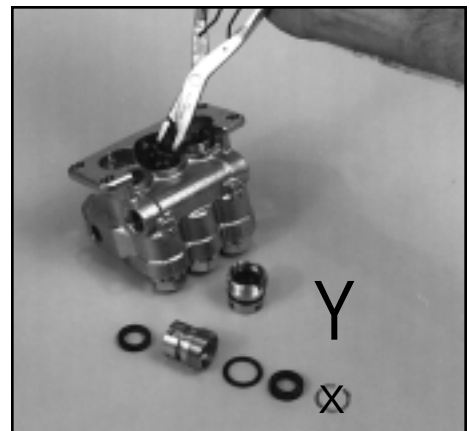
6. Apply Loctite 242 to the threads of the Valve Plug, thread into manifold port and torque per chart.



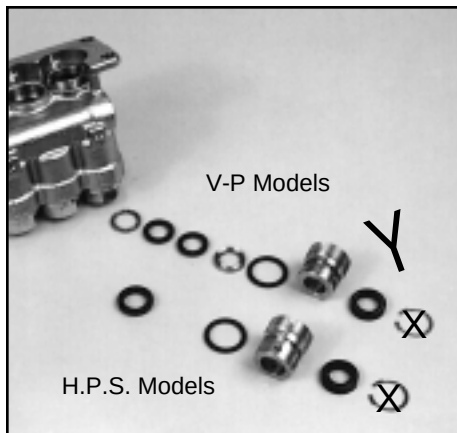
Order of parts in Valve Assembly



Removal of Seal Cases from Manifold Head



Removal of High Pressure Seals



Seal and V-Packing Arrangement



Installation of Male Adapter



Order of Packings [MA, VP, FA]

SERVICING THE SEALS

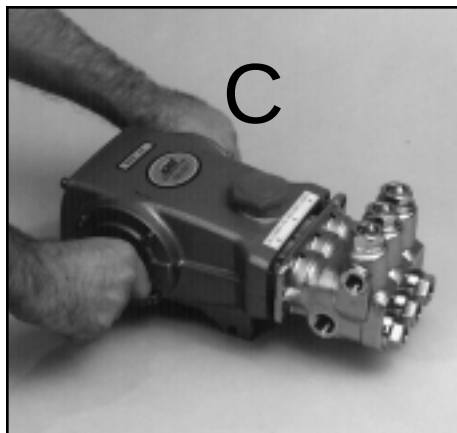
Disassembly

1. Remove the Manifold Head as described in SERVICING THE PLUNGERS section.
2. Place Manifold Head on work surface **with crankcase side up**.
3. On 5PFR and 7PFR plunger pumps prior to May of 1989, remove Snap Ring and Lo-Pressure Seal from each Seal Case. Discard Snap Rings (refer to Tech Bulletin 054).
4. On 5PFR and 7PFR plunger pumps after May of 1989, remove Lo-Pressure Seal from each Seal Case.
5. On 15PFR plunger pumps, remove Snap Ring and Lo-Pressure Seal from each Seal Case.
6. Remove Seal Case from each seal chamber. Remove O-Ring from outside diameter of Seal Case.
7. **Hi-Pressure Seal Models:** The Hi-Pressure Seal is generally easily removed from the manifold without any tools. If extremely worn a reverse pliers may be used.
8. **V-Packing Models:** The Female Adapter, V-Packings and Male Adapter are easily removed from manifold without any tools. If extremely worn a reverse pliers may be used.

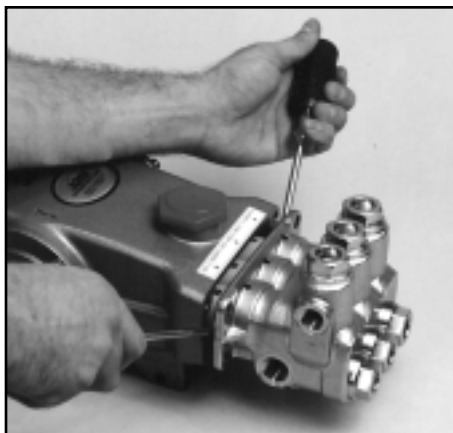
Reassembly

V-Packing Models:

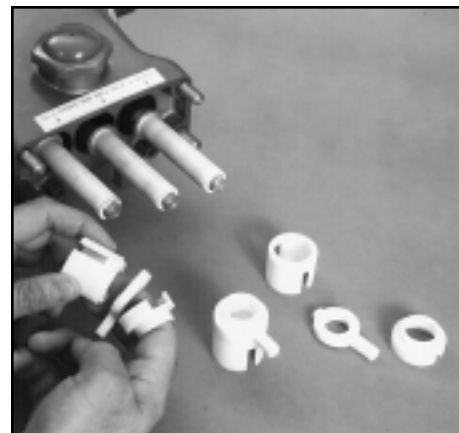
1. Lubricate seal chamber in the manifold.
- NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces (refer to Tech Bulletin 053).**
2. Insert Male Adapter **with notches down and "v" side up** and press completely into chamber by hand.
 3. Lubricate V-Packings and install one at a time with **grooved side down**.
 4. Install Female Adapter with **grooved side down**.
 5. Examine Seal Case O-Ring and replace if worn. Lubricate new O-Rings before installing.
 6. Thread Seal Case into manifold and tighten with special seal case tool. Torque per chart.



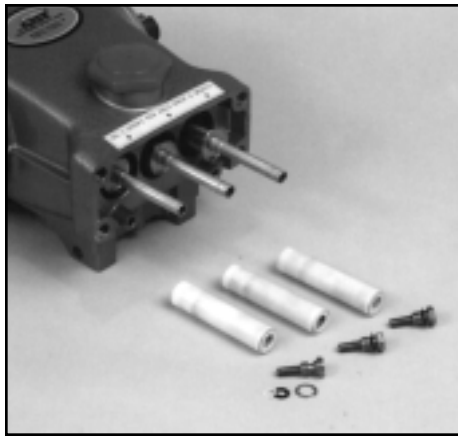
Separating Manifold Head from Crankcase



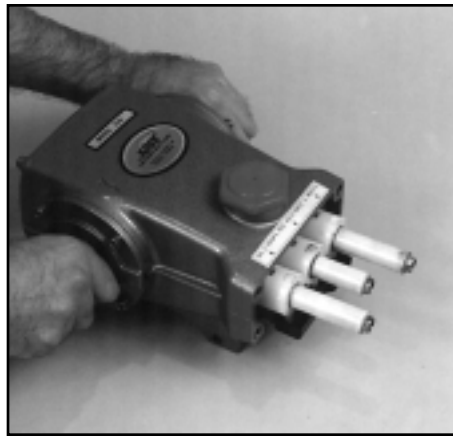
Removal of Manifold Head from Crankcase



Removal of Seal Retainers and Wicks



Ceramic Plunger and Retainer Arrangement



Proper Alignment of Ceramic Plungers for reassembly

Hi-Pressure Seal Models:

1. Lubricate seal chamber in manifold.

NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces (refer to Tech Bulletin 053).

2. Carefully square Hi-Pressure Seal into position by hand with the **grooved side down** (metal back facing out).

NOTE: When alternate materials, the fit of the special materials may be snug and require gently driving the LPS into position with a cylinder of the same diameter to assure a square seating and no damage to the LPS.

3. Examine Seal Case O-Ring and replace if worn. Lubricate new O-Ring before installing.
4. Secure Hi-Pressure Seal into position by threading Seal Case into manifold. Tighten Seal Case with special seal case tool. Torque per chart.

Lo-Pressure Seal - All Models:

1. Examine Lo-Pressure Seals for wear or broken springs and replace if necessary.
2. Install Lo-Pressure Seal into each seal case with **garter spring down**.
3. On 5PFR and 7PFR plunger pumps **do not use** Snap Ring (refer to Tech Bulletin 054).
4. On 15PFR plunger pumps **install Snap Ring** into each Seal Case.
5. Install the Seal Retainer with new Wick onto each plunger rod **with tab down and wick out**.
6. Rotate Crankshaft by hand so the two outside plungers are extended equally.
7. Lightly lubricate the Ceramic Plunger, then carefully slide the Manifold Head over the Ceramic Plunger, supporting it from the underside to avoid damage to the plungers or seals. Press the Manifold Head into the Crankcase until flush.
8. Replace two (2) Lockwashers, two (2) Socket Head Screws for (4) Flange Nuts and torque per chart.

SERVICING THE PLUNGERS

Disassembly

1. Using an M8 allen wrench on the 5PFR pumps, a M14 hex tool on the 7PFR pumps, or a M17 hex tool on the 15PFR pumps, remove the two (2) Socket Head Screws, and two (2) Lockwashers or four (4) Flanged Nuts.
2. Rotate Crankshaft by hand to start separation of Manifold head from Crankcase.
3. Insert two flat head screwdrivers on opposite sides to further separate Manifold Head from Crankcase or support the underside of the Manifold Head and tap lightly with a mallet on the backside of the Manifold Head.

CAUTION: KEEP MANIFOLD PROPERLY ALIGNED WITH CERAMIC PLUNGERS WHEN REMOVING TO AVOID DAMAGE TO EITHER PLUNGERS OR SEALS.

4. Remove Oil Pan and slide out Seal Retainer with Wick.
5. Using an M12 hex tool on the 5, 7 and 15PFR pumps, or an M11 hex tool on the OEM 5, and 7PFR pumps, loosen the Plunger Retainer about three to four turns.
6. Push the Ceramic Plunger back towards the Crankcase to separate it from the Plunger Retainer and proceed with unthreading the Plunger Retainer by hand.
7. Remove the Plunger Retainer, O-Ring, Back-up-Ring and Gasket. Stud may stay on Plunger Rod or come off with Plunger Retainers.
8. Remove the Ceramic Plunger, Keyhole Washer and Barrier Slinger from Plunger Rod.

Reassembly

1. Visually inspect Crankcase Oil Seals for deterioration or leaks. Contact CAT PUMPS for assistance with replacement. See SERVICING THE CRANKCASE section.
2. Examine Barrier Slingers and Keyhole Washers for damage. Slide onto Plunger Rod **with concave side away from Crankcase**.
3. Examine Ceramic Plunger for scoring, scale build-up, chips or cracks and replace as needed.
4. Slide Ceramic Plunger over each Plunger Rod.

NOTE: Ceramic Plunger can only be installed in one direction (front to back). Do not force onto rod.

5. Examine O-Ring and Back-up-Ring on Plunger Retainer and replace if cut or worn. Lubricate O-Rings for ease of installation and to avoid damage to the O-Rings.

6. Install new Gasket, then O-Ring, then Back-up-Ring onto each Plunger Retainer.

NOTE: OEM models have a longer Plunger Retainer Stud.

7. Apply Loctite 242 to exposed threads of Stud and thread Plunger Retainer onto Plunger Rod. Torque per chart.
8. Install the seal Retainer with NEW Wick onto each rod with **tab down and wick out.**

NOTE: Do not lubricate wicks at initial start-up. Operate for 10 to 15 minutes to allow grease from LPS to penetrate the plunger surface, then lubricate as needed.

9. Rotate Crankshaft by hand so the two outside plungers are extended equally.
10. Lightly lubricate the Ceramic Plungers, then carefully slide the Manifold Head over the Ceramic Plungers supporting it from the underside to avoid damage to the Ceramic Plungers or Seals. On the high pressure V-Packing models or larger manifolds, it may be necessary to gently tap with a soft mallet until the manifold is flush with the crankcase.
11. Replace two (2) Lockwashers, two (2) Socket Head Screws or four (4) Flanged Nuts and torque per chart.

SERVICING THE CRANKCASE SECTION

1. While Manifold, Plungers and Seal Retainers are removed, examine Crankcase Oil Seals for leaking and wear.
2. Check for any signs of leaking at Bearing Covers, Rear Cover, Drain Plug or Bubble Gauge.
3. Check oil level and for evidence of water in oil.
4. Rotate Crankshaft by hand to feel for smooth bearing movement.
5. Examine Crankshaft Oil Seals externally for drying, cracking or leaking.
6. Consult CAT PUMPS or your local distributor if crankcase service is evidenced.

See Section I of the Plunger Pump Service Video for additional information.

PREVENTATIVE MAINTENANCE CHECK-LIST

Check	Daily	Weekly	50 hrs.	500 hrs.*	1500 hrs.**	3000 hrs.**
Clean Filters	x					
Oil Level/Quality	x					
Oil Leaks	x					
Water Leaks	x					
Belts, Pulley		x				
Plumbing		x				
Initial Oil Change			x			
Oil Change				x		
Seal Change					x	
Valve Change						x
Accessories					x	

* If other than CAT PUMPS special multi-viscosity ISO68 oil is used, change cycle should be every 300 hours.

** Each system's maintenance cycle will be exclusive. If system performance decreases, check immediately. If no wear at 1500 hours, check again at 2000 hours and each 500 hours until wear is observed. Valves typically require changing every other seal change.

Duty cycle, temperature, quality of pumped liquid and inlet feed conditions all effect the life of pump wear parts and service cycle.

** Remember to service the regulator/unloader at each seal servicing and check all system accessories and connections before resuming operation. Refer to video for additional assistance.

TECHNICAL BULLETIN REFERENCE CHART

No.	Subject	Models
003	Power Unit Drive Packages	3PFR - 68PFR, 10FR - 60FR
024	Lubrication of Lo-Pressure Seals	All Models
027	Spring Retainer	5PFR, 7PFR, 15PFR
032	Shaft Extension and Manifold Port	310, 317, 323, 530, 550
035	Servicing Crankcase Section	7PFR - 60PFR
036	Cylinder and Plunger Reference Chart	All Models
043	LPS and HPS Servicing	All Plunger Models
045	One-Piece S.S. Plunger Retainer w/Stud	5PFR, 7PFR, 15PFR
046	Valve Plug with Coil Spring	317, 347, 357, 1057
047	Blind Bearing Shaft Cover	Gearbox Plunger Pumps
048	Extended Valve Plug	7PFR and 15PFR
049	Stainless Steel Hardware	3PFR7, 5PFR7, 15PFR7
051	M10 Manifold and Crankcase	7PFR and OEM
052	Plunger Rod and Stud	3PFR, 5PFR, 15PFR, 35PFR, 60PFR
053	Liquid Gasket	All Plunger NAB-S.S. Models
054	2 Piece Seal Retainer	5PFR and 7PFR
058	Forged Manifold and Extended Valve Plugs	56, 57, 59, 60
060	Baffle Assembly	34170
061	Installation and Adjustment Procedure	8100
062	Manifold and Seal Case	650 and 651
064	By-Pass Hose Sizing	All Unloaders/Regulators
067	S.S. Plunger Retainer	3PFR, 5PFR, 7PFR
072	Manifold Head and V-Packing	1050, 1051, 1057
073	Hi-Temp HPS	3PFR, 5PFR, 2SF
074	Torque Chart	Piston and Plunger Pumps
077	Oil Drain Kit	All Models (except 2SF/4SF)
083	Winterizing a Pump	All Models

TORQUE CHART						
Pump Item				Torque		
Pump Model	Thread	Tool Size [P/N]	in. lbs.	ft. lbs.	Nm	
PLUNGER RETAINER						
OEM Models	M6	M11 Hex [44044]	55	4.4	6	
All Standard Models.....	M6	M12 Hex	55	4.4	6	
MANIFOLD HEAD BOLTS						
5PFR	30, 31, 34, 35..... 310, 340, 350 311, 341, 351 317, 347, 357	M10	M8 Allen [25052]	220	18.1	25
5PFR	42HS, 43HS, 45.....	M10	M8 Allen [33046]	220	18.1	25
7PFR	510, 530, 550..... 56, 57, 58, 59, 60, 70	M10	M14 Hex [25053]	220	18.1	25
15PFR	650, 651, 660, 661..... 1050, 1051, 1057	M10	M17 Hex [25083]	220	18.1	25
VALVE PLUGS						
5PFR	30, 31, 34, 35..... 310, 311, 317 340, 341, 347 350, 351, 357 42HS	M22	M24 Hex [44046]	870	72.3	98
5PFR	43HS, 45.....	M25	M24 Hex [44046]	520	43.4	59
7PFR	530, 550 51, 55, 56, 57, 58 59, 60, 70	3/4" SPT	M27 Hex [44045]	870	72.3	98
15PFR	650, 651, 660, 661 1050, 1051, 1057	3/4" SPT	M27 Hex [44045]	870	72.3	98
CRANKCASE COVER/BEARING COVER SCREWS						
5PFR	30, 31, 34, 35..... 310, 340, 350 317, 347, 357 311, 341, 351	M6	M10 Hex/Phil. [25082]	50	4.0	6
5PFR	42HS, 43HS, 45.....	M6	M10 Hex/Phil. [25082]	50	4.0	6
		M8	M13 Hex [25324]	115	9.4	13
7PFR	51, 53, 55, 56, 57,..... 59, 60, 70	M6	M10 Hex [25082]	115	9.4	13
15PFR	650, 1050.....	M6	M10 Hex [25082]	50	4.0	5.7
SEAL CASE						
5PFR	30, 31, 34, 35 310, 311, 317 340, 341, 347 350, 351, 357 42HS, 43HS, 45	N/A	1/2" Soc. Drive [33004]	354	29.5	40
		N/A	1/2" Soc. Drive [33005]	354	29.5	40
7PFR	51, 53, 55, 56, ... 57, 58, 59, 60, 70 530, 550	N/A	1/2" Soc. Drive [33005]	354	29.5	40
15PFR	650, 651, 660, 661 1050, 1051, 1057	N/A	1/2" Soc. Drive [33006]	346	28.8	39
		N/A	1/2" Soc. Drive [33006]	390	32.5	44
BUBBLE OIL GAUGE						
All Models.....	M28	Oil Gauge Tool [44050]	45	3.6	5	
MOUNTING BOLTS						
5PFR, 7PFR.....	M8	M13 Hex [25324]	115	9.4	13	
15PFR	M10	M17 Hex [25083]	240	19.7	29	

INLET CONDITION CHECK-LIST

Review Before Start-Up

Inadequate inlet conditions can cause serious malfunctions in the best designed pump. Surprisingly, the simplest of things can cause the most severe problems or go unnoticed to the unfamiliar or untrained eye. **REVIEW THIS CHECK-LIST BEFORE OPERATION OF ANY SYSTEM.** Remember, no two systems are alike, so there can be no **ONE** best way to set-up a system. All factors must be carefully considered.

INLET SUPPLY should exceed the maximum flow being delivered by the pump to assure proper performance.

- ☐ Open inlet shut-off valve and turn on water supply to avoid starving the pump. **DO NOT RUN PUMP DRY.**
- ☐ Temperatures above 130°F are permissible. Add 1/2 PSI inlet pressure per each degree F over 130°F. Elastomer or RPM changes may be required. See Tech Bulletin 002 or call CAT PUMPS for recommendations.
- ☐ Avoid closed loop systems especially with high temperature, ultra-high pressure or large volumes. Conditions vary with regulating/unloader valve.
- ☐ Low vapor pressure liquids, such as solvents, require a booster pump and C.A.T. to maintain adequate inlet supply.
- ☐ Higher viscosity liquids require a positive head and a C.A.T. to assure adequate inlet supply.
- ☐ Higher temperature liquids tend to vaporize and require positive heads and C.A.T. to assure adequate inlet supply.
- ☐ When using an inlet supply reservoir, size it to provide adequate liquids to accommodate the maximum output of the pump, generally a minimum of 6-10 times the GPM (however, a combination of system factors can change this requirement); provide adequate baffling in the tank to eliminate air bubbles and turbulence; install diffusers on all return lines to the tank.

INLET LINE SIZE should be adequate to avoid starving the pump.

- ☐ Line size must be a minimum of one size larger than the pump inlet fitting. Avoid tees, 90 degree elbows or valves in the inlet line of the pump to reduce the risk of flow restriction and cavitation.
- ☐ The line **MUST** be a FLEXIBLE hose, NOT a rigid pipe, and reinforced on SUCTION systems to avoid collapsing.
- ☐ The simpler the inlet plumbing the less the potential for problems. Keep the length to a minimum, the number of elbows and joints to a minimum (ideally no elbows) and the inlet accessories to a minimum.
- ☐ Use pipe sealant to assure air-tight, positive sealing pipe joints.

INLET PRESSURE should fall within the specifications of the pump.

- ☐ Acceleration loss of liquids may be increased by high RPM, high temperatures, low vapor pressures or high viscosity and may require pressurized inlet and C.A.T. to maintain adequate inlet supply. **DO NOT USE C.A.T. WITH SUCTION INLET.**
- ☐ Optimum pump performance is obtained with +20 PSI (1.4 BAR) inlet pressure and a C.A.T. for certain applications. With adequate inlet plumbing, most pumps will perform with flooded suction. Maximum inlet pressure is 60 PSI (4 BAR).
- ☐ After prolonged storage, pump should be rotated by hand and purged of air to facilitate priming. Disconnect the discharge port and allow liquid to pass through pump and measure flow.

INLET ACCESSORIES are designed to protect against overpressurization, control inlet flow, contamination or temperature and provide ease of servicing.

- ☐ A shut-off valve is recommended to facilitate maintenance.
- ☐ Installation of a C.A.T. is essential in applications with stressful conditions such as high temperatures, booster pump feed or long inlet lines. **Do not use C.A.T. with negative inlet pressure.**
- ☐ A stand pipe can be used in some applications to help maintain a positive head at the pump inlet.
- ☐ Inspect and clean inlet filters on a regular schedule to avoid flow restriction.
- ☐ A pressure transducer is necessary to accurately read inlet pressure. **(Short term, intermittent cavitation will not register on a standard gauge.)**
- ☐ All accessories should be sized to avoid restricting the inlet flow.
- ☐ All accessories should be compatible with the solution being pumped to prevent premature failure or malfunction.
- ☐ Optional inlet protection can be achieved by installing a pressure cutoff switch between the inlet filter and the pump to shut off pump when there is no positive inlet pressure.

BY-PASS TO INLET Care should be exercised when deciding the method of by-pass from control valves.

- ☐ It is recommended the by-pass be directed to a baffled reservoir tank, with at least one baffle between the by-pass line and the inlet line to the pump.
- ☐ Although not recommended, by-pass liquid may be returned to the inlet line of the pump if the system is properly designed to protect your pump. A **PRESSURE REDUCING VALVE** must be installed on the inlet line (**BETWEEN** THE BY-PASS CONNECTION AND THE INLET TO THE PUMP) to avoid excessive pressure to the inlet of the pump. It is also recommended that a **THERMO VALVE** be used in the by-pass line to monitor the temperature build-up in the by-pass loop to avoid premature seal failure.
- ☐ A low-pressure, flexible cloth braid (not metal braid) hose should be used from the by-pass connection to the inlet of the pump.
- ☐ Caution should be exercised not to undersize the by-pass hose diameter and length. Refer to Technical Bulletin 64 for additional information on the size and length of the by-pass line.
- ☐ Check the pressure in the by-pass line to avoid overpressurizing the inlet.
- ☐ The by-pass line should be connected to the pump inlet line at a gentle angle of 45° or less and no closer than 10 times the pump inlet port diameter e.g. 1-1/2" port size = 15" distance from pump inlet port.

HOSE FRICTION LOSS

Water* Flow Gal/Min	PRESSURE DROP IN PSI PER 100 FT OF HOSE WITH TYPICAL WATER FLOW RATES Hose Inside Diameters, Inches						
	1/4	5/16	3/8	1/2	5/8	3/4	1"
0.5	16	5	2				
1	54	20	7	2			
2	180	60	25	6	2		
3	380	120	50	13	4	2	
4		220	90	24	7	3	
5		320	130	34	10	4	
6			220	52	16	7	1
8			300	80	25	10	2
10			450	120	38	14	3
15			900	250	80	30	7
20			1600	400	121	50	12
25				650	200	76	19
30					250	96	24
40					410	162	42
50					600	235	62
60						370	93

*At a fixed flow rate with a given size hose, the pressure drop across a given hose length will be directly proportional. A 50 ft. hose will exhibit one-half the pressure drop of a 100 ft. hose. Above values shown are valid at all pressure levels.

WATER LINE PRESSURE LOSS PRESSURE DROP IN PSI PER 100 FEET

Water GPM	Steel Pipe—Nominal Dia.						Brass Pipe—Nominal Dia.						Copper Tubing O.D. Type L							
	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	1/4	3/8	1/2	5/8	3/4	7/8
1	8.5	1.9						6.0	1.6						120	13	2.9	1.0		
2	30	7.0	2.1					20	5.6	1.8					400	45	10	3.4	1.3	
3	60	14	4.5	1.1				40	11	3.6					94	20	6.7	2.6		
5	150	36	12	2.8				100	28	9.0	2.2				230	50	17	6.1	3.0	
8	330	86	28	6.7	1.9			220	62	21	5.2	1.6			500	120	40	15	6.5	
10	520	130	43	10	3.0			320	90	30	7.8	2.4			180	56	22	10		
15	270	90	21	6.2	1.6			190	62	16	5.0	1.5			120	44	20			
25	670	240	56	16	4.2	2.0		470	150	40	12	3.8	1.7		330	110	50			
40					66	17	8.0					39	11	5.0				550	200	88
60						37	17						23	11						
80							52	29					40	19						
100						210	107	48					61	28						

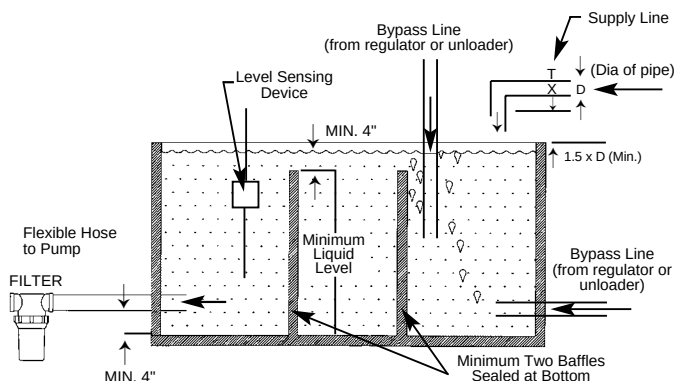
RESISTANCE OF VALVES AND FITTINGS

Nominal Pipe Size Inches	Inside Diameter Inches	Equivalent Length of Standard Pipe in Feet							
		Gate Valve	Globe Valve	Angle Valve	45° Elbow	90° Elbow	180° Close Ret	Tee Thru Run	Tee Thru Branch
1/2	0.622	0.41	18.5	9.3	0.78	1.67	3.71	0.93	3.33
3/4	0.824	0.54	24.5	12.3	1.03	2.21	4.90	1.23	4.41
1	1.049	0.69	31.2	15.6	1.31	2.81	6.25	1.56	5.62
1¼	1.380	0.90	41.0	20.5	1.73	3.70	8.22	2.06	7.40
1½	1.610	1.05	48.0	24.0	2.15	4.31	9.59	2.40	8.63
2	2.067	1.35	61.5	30.8	2.59	5.55	12.30	3.08	11.60
2½	2.469	1.62	73.5	36.8	3.09	6.61	14.70	3.68	13.20
3	3.068	2.01	91.5	45.8	3.84	8.23	18.20	4.57	16.40
4	4.026	2.64	120.0	60.0	5.03	10.80	23.90	6.00	21.60

Arriving at a total line pressure loss, consideration should then be given to pressure loss created by valves, fittings and elevation of lines.

If a sufficient number of valves and fittings are incorporated in the system to materially affect the total line loss, add to the total line length, the equivalent length of line of each valve or fitting.

TYPICAL RESERVOIR TANK RECOMMENDED 6 TO 10 TIMES SYSTEM CAPACITY



Handy Formulas to Help You

Q. How can I find the RPM needed to get specific GPM (Gallons Per Minute) I want?

$$A. \text{Desired RPM} = \text{Desired GPM} \times \frac{\text{Rated RPM}}{\text{Rated GPM}}$$

Q. I have to run my pump at a certain RPM. How do I figure the GPM I'll get?

$$A. \text{Desired GPM} = \text{Desired RPM} \times \frac{\text{Rated GPM}}{\text{Rated RPM}}$$

Q. Is there a simple way to find the approximate horsepower I'll need to run the pump?

$$A. \text{Electric Brake Horsepower Required} = \frac{\text{GPM} \times \text{PSI}}{1460} \quad (\text{Standard 85\% Mech. Efficiency})$$

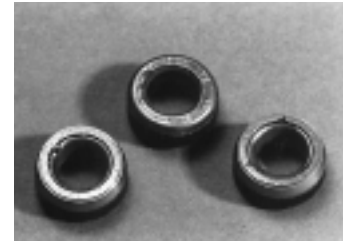
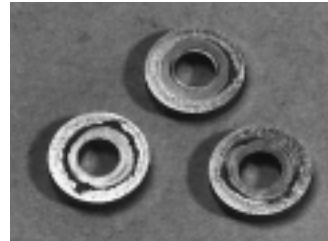
Q. What size motor pulley should I use?

$$A. \text{Pump Pulley (Outer Diameter)} \times \frac{\text{Pump RPM}}{\text{Motor/Engine RPM}} \quad (\text{Consult Engine Mfr.})$$

Q. How do I calculate the torque for my hydraulic drive system?

$$A. \text{Torque (ft. lbs.)} = 3.6 \left(\frac{\text{GPM} \times \text{PSI}}{\text{RPM}} \right)$$

Avoid Cavitation Damage



One or several of the conditions shown in the chart below may contribute to cavitation in a system resulting in premature wear, system downtime and unnecessary operating costs.

CONDITION	SOLUTION
Inadequate inlet line size	• Increase line size to the inlet port or one size larger
Water hammering liquid acceleration/deacceleration	• Install C.A.T. Tube • Move pump closer to liquid supply
Rigid Inlet Plumbing	• Use flexible wire reinforced hose to absorb pulsation and pressure spikes
Excessive Elbows in Inlet Plumbing	• Keep elbows to a minimum and less than 90°
Excessive liquid Temperature	• Use Thermo Valve in bypass line • Do not exceed pump temperature specifications • Substitute closed loop with baffled holding tank • Adequately size tank for frequent or high volume bypass • Pressure feed high temperature liquids • Properly ventilate cabinets and rooms
Air Leaks in Plumbing	• Check all connections • Use PTFE thread tape or pipe thread sealant
Agitation in Supply Tank	• Size tank according to pump output — Minimum 6-10 times system GPM • Baffle tank to purge air from liquid and separate inlet from discharge
High Viscosity Liquids	• Verify viscosity against pump specifications before operation • Elevate liquid temperature enough to reduce viscosity • Lower RPM of pump • Pressure feed pump • Increase inlet line size
Clogged Filters	• Perform regular maintenance or use clean filters to monitor build up • Use adequate mesh size for liquid and pump specifications

DIAGNOSIS AND MAINTENANCE

One of the most important steps in a high pressure system is to establish a regular maintenance program. This will vary slightly with each system and is determined by various elements such as the duty cycle, the liquid being pumped, the actual specifications vs rated specifications of the pump, the ambient conditions, the inlet conditions and the accessories in the system. A careful review of the necessary inlet conditions and protection devices required before the system is installed will eliminate many potential problems.

CAT PUMPS are very easy pumps to service and require far less frequent service than most pumps. Typically, only common tools are required, making in-field service convenient, however, there are a few custom tools, special to certain models, that do simplify the process. This service manual is designed to assist you with the disassembly and reassembly of your pump. The following guide will assist in determining the cause and remedy to various operating conditions. You can also review our **FAQ** or **SERVICE** sections on our **WEB SITE** for more facts or contact CAT PUMPS directly.

PROBLEM	PROBABLE CAUSE	SOLUTION
Low pressure	•Worn nozzle. •Belt slippage. •Air leak in inlet plumbing. •Pressure gauge inoperative or not registering accurately. •Relief valve stuck, partially plugged or improperly adjusted. •Inlet suction strainer (filter) clogged or improperly sized. •Abrasives in pumped liquid. •Leaky discharge hose. •Inadequate liquid supply. •Severe cavitation. •Worn seals. •Worn or dirty inlet/discharge valves.	•Replace with properly sized nozzle. •Tighten belt(s) or install new belt(s). •Tighten fittings and hoses. Use PTFE liquid or tape. •Check with new gauge. Replace worn or damaged gauge. •Clean/adjust relief valve. Replace worn seats/valves and o-rings. •Clean filter. Use adequate size filter. Check more frequently. •Install proper filter. •Replace discharge hose with proper rating for system. •Pressurize inlet and install C.A.T. •Check inlet conditions. •Install new seal kit. Increase frequency of service. •Clean inlet/discharge valves or install new valve kit.
Pulsation	•Faulty Pulsation Dampener. •Foreign material trapped in inlet/discharge valves.	•Check precharge. If low, recharge, or install a new dampener. •Clean inlet/discharge valves or install new valve kit.
Water leak		
•Under the manifold	•Worn V-Packings, Hi-Pressure or Lo-Pressure Seals. •Worn adapter o-rings.	•Install new seal kit. Increase frequency of service. •Install new o-rings.
•Into the crankcase	•Humid air condensing into water inside the crankcase. •Excessive wear to seals and V-Packings.	•Install oil cap protector. Change oil every 3 months or 500 hours. •Install new seal kit. Increase frequency of service.
Knocking noise		
•Inlet supply	•Inadequate inlet liquid supply.	•Check liquid supply. Increase line size, pressurize or install C.A.T.
•Bearing	•Broken or worn bearing.	•Replace bearing.
•Pulley	•Loose pulley on crankshaft	•Check key and tighten set screw.
Oil leak		
•Crankcase oil seals.	•Worn crankcase oil seals.	•Replace crankcase oil seals.
•Crankshaft oil seals and o-rings.	•Worn crankshaft oil seals or o-rings on bearing cover.	•Remove bearing cover and replace o-rings and/or oil seals.
•Drain plug	•Loose drain plug or worn drain plug o-ring.	•Tighten drain plug or replace o-ring.
•Bubble gauge	•Loose bubble gauge or worn bubble gauge gasket.	•Tighten bubble gauge or replace gasket.
•Rear cover	•Loose rear cover or worn rear cover o-ring.	•Tighten rear cover or replace o-ring.
•Filler cap	•Loose filler cap or excessive oil in crankcase.	•Tighten filler cap. Fill crankcase to specified capacity.
Pump runs extremely rough		
•Inlet conditions	•Restricted inlet or air entering the inlet plumbing	•Correct inlet size plumbing. Check for air tight seal.
•Pump valves	•Stuck inlet/discharge valves.	•Clean out foreign material or install new valve kit.
•Pump seals	•Leaking V-Packings, Hi-Pressure or Lo-Pressure seals.	•Install new seal kit. Increase frequency of service.
Premature seal failure	•Scored plungers. •Over pressure to inlet manifold. •Abrasive material in the liquid being pumped. •Excessive pressure and/or temperature of pumped liquid. •Running pump dry. •Starving pump of adequate liquid. •Eroded manifold.	•Replace plungers. •Reduce inlet pressure per specifications. •Install proper filtration at pump inlet and clean regularly. •Check pressure and inlet liquid temperature. •DO NOT RUN PUMP WITHOUT LIQUID. •Increase hose one size larger than inlet port size. Pressurize and install C.A.T. •Replace manifold. Check liquid compatibility.

STA-RITE®

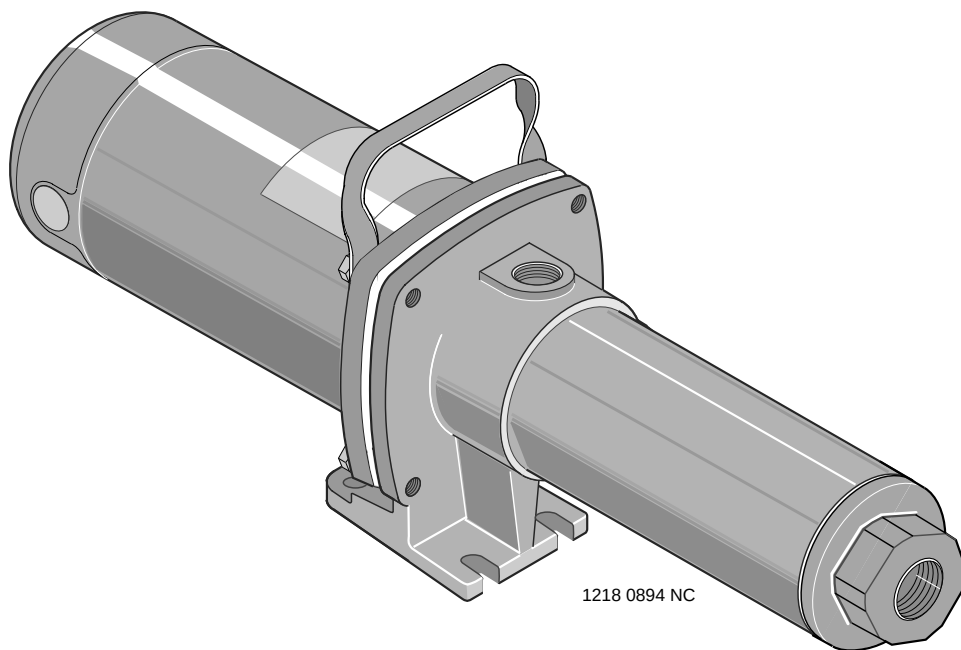
OWNER'S MANUAL

INSTALLATION AND OPERATING INSTRUCTIONS
REPAIR PARTS LIST

Signature 2000

High Pressure Booster Pump

60 Hz. 1/2 through 3 HP



1218 0894 NC

STA-RITE INDUSTRIES, DELAVAN, WISCONSIN 53115



 **DANGER**

 **WARNING**

 **CAUTION**

ELECTRICAL SAFETY

 **WARNING**



Hazardous voltage.
Can shock, burn, or
cause death.

Ground pump before
connecting to power
supply.

 Some models of pump are supplied with 3-connector grounding type cord. Connect only to properly grounded, GFCI protected outlet. Do not lift pump by electrical cord.

 Pump is non-submersible. Keep motor dry at all times. Do not wash motor. Do not immerse. Protect motor from wet weather.

 If using extension cord, use only UL approved indoor/outdoor,

3-wire, grounding type cord. Do not allow any part of cord or receptacle ends to sit in water or damp locations.

 **Unplug pump before servicing.**

 **CAUTION** Burn Hazard. Do not touch an operating motor. Modern motors can operate at high temperatures. To avoid burns when servicing pump, allow it to cool for 20 minutes after shut-down before handling.

Follow local and/or national plumbing and electrical codes when installing.

 **WARNING** Hazardous Pressure. DO NOT run the pump with discharge shutoff, as hose may burst or pump may be damaged due to high temperatures.

READ AND FOLLOW SAFETY INSTRUCTIONS!

This is the safety alert symbol. When you see this symbol on your pump or in this manual, look for one of the following signal words and be alert to the potential for personal injury:

DANGER warns about hazards that **will** cause serious personal injury, death or major property damage if ignored.

WARNING warns about hazards that **can** cause serious personal injury, death or major property damage if ignored.

CAUTION warns about hazards that **will** or **can** cause minor personal injury or property damage if ignored.

The word **NOTICE** indicates special instructions which are important but not related to hazards.

GENERAL SAFETY

To avoid risk of serious bodily injury and property damage, read safety instructions carefully before installing pump.

Do not allow pump or any system component to freeze. To do so may damage system and will void warranty.

 **WARNING** Risk of electric shock. To avoid fatal shocks, proceed as follows if pump needs servicing.

- Disconnect power to pump outlet box before pulling pump cord plug.** After plug is pulled, let pump cool for 20 minutes before attempting to work on it.
- Take extreme care when changing fuses.** To reduced chance of fatal electrical shocks, **DO NOT** stand in water or put your finger in the fuse socket.
- Ground** electrical outlet box.
- Use only Ground Fault Circuit Interrupter (GFCI) protected grounded outlet** for cord plug.

Never run pump dry. Running pump dry can damage internal parts, overheat pump (which can cause burns to people handling or servicing pump), and will void warranty.

Do not pump chemicals or corrosive liquids with pump.

 **WARNING** Hazardous Pressure.

- Use high pressure reinforced type discharge hose ONLY.** See parts list for available hose, nozzle and fittings. A high pressure relief valve is recommended.
- DO NOT use garden hose with High Pressure Booster pump.** Garden hose will not stand the discharge pressure produced and will fail.
- High pressure discharge stream is dangerous.** To avoid injury, **DO NOT aim the discharge stream at any person or animal.**
- BE SURE that the pump suction pipe pressure plus the pump discharge pressure does not exceed the pressure rating of hose and fittings.** See Table I for pump discharge pressure ratings.

INSPECT THE SHIPMENT

The high pressure booster pump has been carefully inspected and packaged to assure safe delivery. Inspect the pump and fittings and report to the carrier any items which are damaged or missing.

TABLE I - DISCHARGE PRESSURE

GPM	HP	No. of Stages	Discharge Pressure PSI at Rated Flow	Discharge Pressure PSI at No Flow
7	1/2	9	90	130
7	3/4	12	123	173
7	1	16	162	229
10	1/2	6	74	113
10	3/4	8	97	147
10	1	10	134	188
10	1	11	146	202
10	1-1/2	14	173	206
10	2	16	197	260
20	1	7	75	110
20	1-1/2	9	97	143
20	2	11	123	175
20	3	15	195	250
30	1	5	59	75
30	1-1/2	6	71	91
30	2	7	81	106
30	3	11	129	167

***For total discharge pressure, add this pressure to suction pipe pressure. For example, an HP7C pump taking suction from a 100 psi water service line will produce $130 + 100 = 230$ psi total discharge pressure at 0 GPM flow. If suction pressure drops to 50 psi, discharge pressure will drop to 180 psi.**

NOTE: Model numbers that include an "S" (HPS7C, HPS10D, etc) have a stainless steel suction, discharge assembly, and capscrews. Model numbers ending in "3" (HP7C3, HPS10C3, etc) have 3-phase motors. Models numbers ending in "T" have TEFC motors.

INSTALLATION

The pump is designed to boost city water pressure or water pressure from a private water system. Use this high pressure stream to wash down milk parlors, barns, garages and driveways, or for fire protection.

The pump is portable with a convenient carrying handle. If an existing pressure water system is to be used as a water supply, it can be connected with available fittings and 3/4" or 1" high pressure hose to the pump inlet. A special heavy duty 3/4" or 1" suction hose with fittings is available as an accessory. If pump is permanently mounted on wall, use a 3/4" or 1" pipe or heavy-duty hose for suction line. 20 GPM models require one-inch discharge hose to reduce friction losses and 30 GPM models require 1-1/4".

⚠ WARNING Hazardous pressure. Pump body may explode if pressures exceed rated limits. Maximum inlet pressure is 80 PSI. Maximum discharge pressure is 315 PSI. Warranty is void if these pressure limits are exceeded.

HIGH PRESSURE BOOSTER PUMP INSTALLATION INSTRUCTIONS

These instructions cover high pressure booster pump installations as shown below:

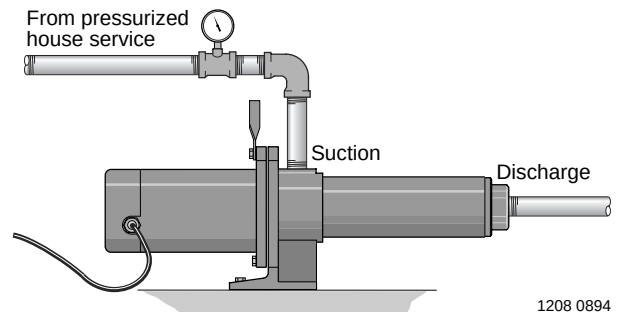


Figure 1 – Connection to house service.

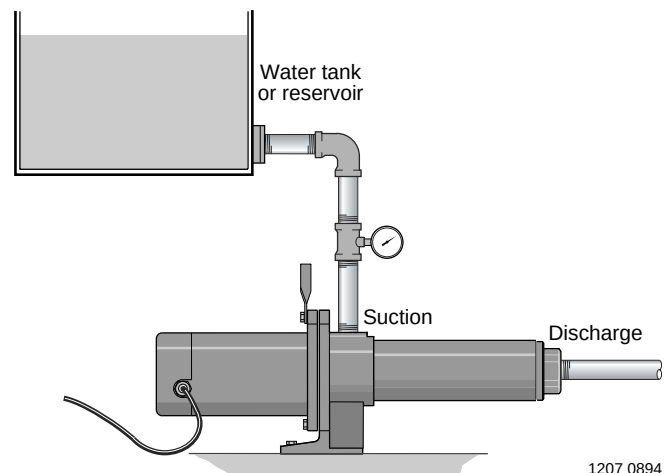


Figure 2 – Connection to water reservoir.

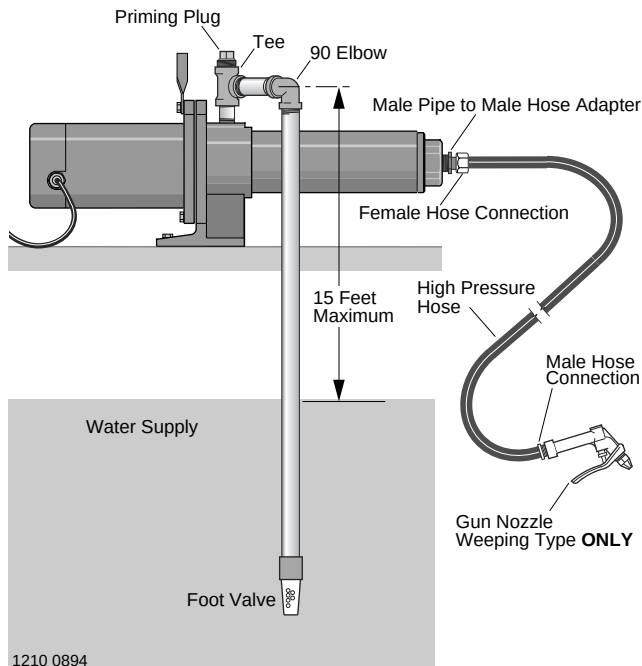


Figure 3 – Cistern or shallow well installation.

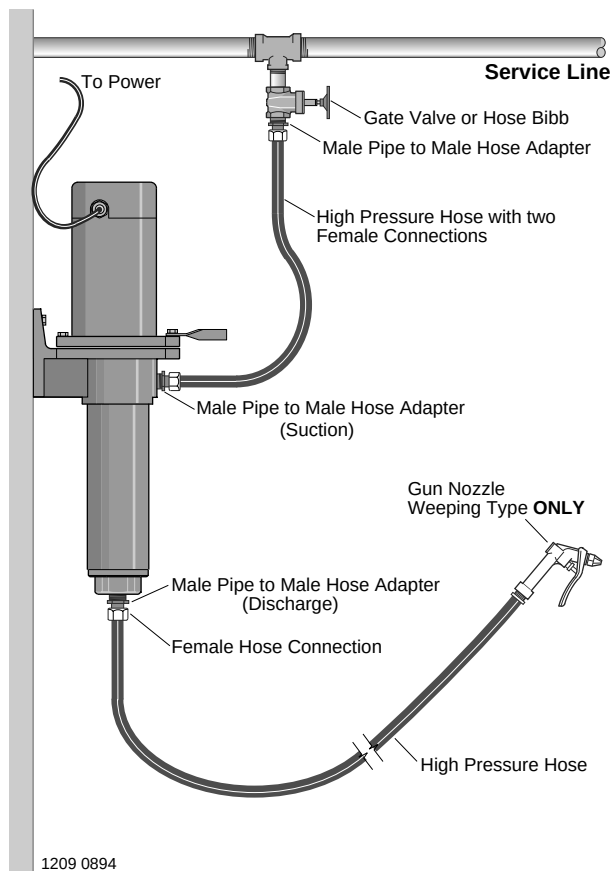


Figure 4 – Wall mounted to pressurized service line.

To reduce friction losses to a minimum, inlet (suction) line should be **short** and have as few elbows as possible.

Size the inlet according to the chart below:

Ave. GPM	Threaded Inlet Size	Recommended Inlet Line Size	Recommended Discharge Line Size
7	3/4" NPT	1"	1"
10	3/4" NPT	1"	1"
20	1" NPT	1-1/4"	1-1/4"
30	1-1/4" NPT	1-1/2"	1-1/2"

An inlet strainer will prevent suspended debris from clogging pump.

The internal running surfaces of the pump and seals require water lubrication for good, consistent operation. **Allowing pump to run dry will severely damage pump and seals.**

Install a pressure gauge in pump inlet line. Keep at least two pounds per square inch pressure (2 PSI) in inlet line whenever pump is operating. If this is not possible, consult customer service representative.

LUBRICATION

It is not necessary to lubricate pump or motor. The motor is equipped with sealed ball bearings, lubricated for the life of the bearing. The mechanical shaft seal in the pump is self-lubricating and requires no adjustment. Disassemble pump to replace seal (See "Maintenance", Pages 8 to 9).

OPERATION

NOTICE: Observe the following precautions when operating the pump:

1. **Keep the motor dry! Do not** direct stream from pump discharge onto the motor!
2. **⚠ WARNING Hazardous pressure. Do not** run the pump with discharge shutoff, as hose may burst or pump may be damaged due to high temperatures.
3. **Do not** use a standard trigger gun with this pump. Use only trigger guns with an automatic weeping feature. These are available as accessories and are provided with three nozzles. The smallest nozzle restricts the flow, allowing use of a smaller water source. The two larger nozzles are used if the water source will supply the pump's full capacity.
4. **Do not** run pump dry; to do so may damage the seal.
5. To avoid internal damage to pump, **Do not** operate with water temperature above 175 degrees F.

⚠ Disconnect power before working on pump, motor, pressure switch, or wiring.

Single Phase, ODP Motor

MOTOR SWITCH SETTINGS

Dual-voltage motors (motors that can operate at either 115 or 230 volts), are set at the factory to 230 volts. Do not change motor voltage setting if line voltage is 230 volts, or if you have a single voltage motor.*

NOTE: Never wire a 115 volt motor to a 230 volt line.

REMOVE MOTOR END COVER

If you have a dual-voltage motor, and will connect it to 115 volts, follow the procedure below.

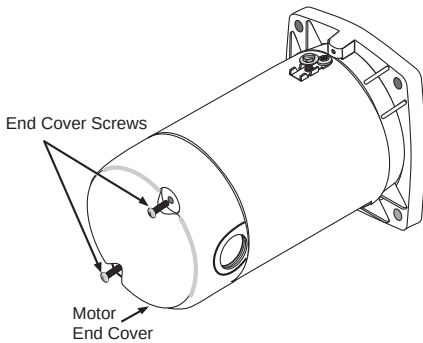


Figure 5 – Removing Motor End Cover

You will need to remove the motor end cover to change the voltage setting.

Your motor terminal board (located under the motor end cover) should look like one of those below.

PLUG TYPE VOLTAGE SELECTOR

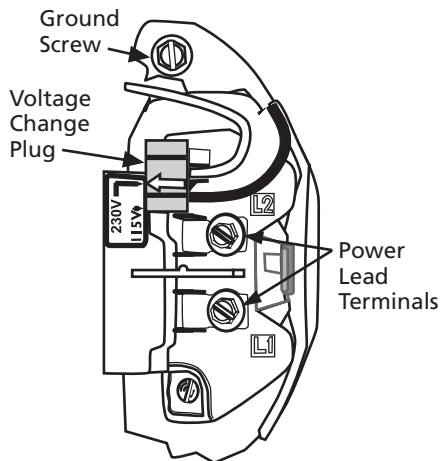


Figure 6 – Voltage set to 230 volts, Plug Type

To change to 115 volts:

1. Make sure power is off.
2. Pull the plug straight up.

**Models with power cords are pre-wired for 115 volts. This includes models HP7D-02 and HP7C-02.*

3. Move and attach the plug at the 115 volt position. The plug will now cover 2 metal tabs. The arrow on the plug will point to 115V.
 4. Attach the power lead wires to the power lead terminals. Make sure the wires are secure.
 5. Attach the ground wire to the green ground screw
 6. Reinstall the Motor end cover
- Go to Wiring Connections below.

DIAL TYPE VOLTAGE SELECTOR

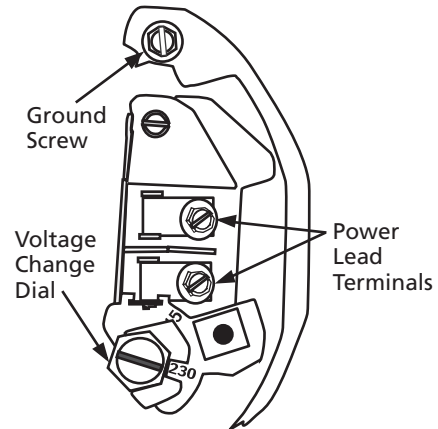


Figure 7 – Voltage set to 230 volts, Dial Type

To change to 115 volts:

1. Make sure power is off.
 2. Turn the dial counter-clockwise until 115 shows in the dial window.
 3. Attach the power lead wires to the power lead terminals. Make sure the wires are secure.
 4. Attach the ground wire to the green ground screw
 5. Reinstall the Motor end cover
- Go to Wiring Connections below.

ELECTRICAL

-  **Ground motor before connecting to electrical power supply.**
-  **Failure to ground motor can cause severe or fatal electrical shock hazard.**
-  **Explosion hazard. Do not ground to a gas supply line.**
-  **To avoid dangerous or fatal electrical shock, turn OFF power to motor before working on electrical connections.**
-  **Supply voltage must be within $\pm 10\%$ of nameplate voltage. Incorrect voltage can cause fire or serious damage to motor and voids warranty. If in doubt consult a licensed electrician.**
-  **Use wire size specified in Wiring Chart (Table II, Page 7). If possible, connect pump to a separate branch circuit with no other appliances on it.**
-  **Wire motor according to diagram on motor nameplate. If nameplate diagram differs from diagrams above, follow nameplate diagram.**

For All 3-phase and TEFC Motors: Follow the wiring diagram on the motor junction box or on the motor nameplate.

WIRING CONNECTIONS

1. Install, ground, wire and maintain this pump in compliance with the National Electrical Code (NEC) or the Canadian Electrical Code (CEC) and with all local codes and ordinances that apply. Consult your local building inspector for local information.
2. Make sure that the voltage, frequency and phase (single phase or three phase) of the power supply agree with that stamped on the motor nameplate. If in doubt, check with the power company.
3. Some models are equipped with three phase motors. Three phase motors require magnetic starters and can run in either direction, depending on how they are connected to the power supply.

NOTICE: Dual voltage motors without cords are factory wired for 230 volts. If necessary, reconnect the motor for 115 volts, as shown. All cord connected motors are wired for 115 volts (See Page 5). Do not alter the wiring in single voltage motors.

Install, ground, wire, and maintain your pump in compliance with the National Electrical Code (NEC) or the Canadian Electrical Code (CEC), as applicable, and with all local codes and ordinances that apply. Consult your local building inspector for code information.

NOTICE: Clamp the power cable to prevent strain on the terminal screws.

NOTICE: Your Motor Terminal Board (under the motor end cover) looks like one of those shown above. Do not change motor wiring if line voltage is 230 volts. Connect power supply as shown for your supply voltage.

NOTICE: Some models are equipped with three phase motors. Three phase motors require magnetic starters and can run in either direction, depending on how they are connected to the power supply.

To Check For Proper Rotation – 3 Phase Motors

▲WARNING Risk of electrical shock.

1. Be sure power is disconnected to motor when working on electrical connections.
2. Remove the motor end cover, exposing motor shaft. Momentarily start pump. If hookup is correct, the shaft will rotate clockwise.
3. If rotation is not clockwise, reverse any two leads to the starter. The rotation will now be correct.

GROUNDING THE MOTOR

Ground the pump permanently using a wire of size and type specified by local or National Electrical Code.

Models (HP7C and HP7D Series Only) with factory installed cord and plug:

▲WARNING Risk of electric shock. This equipment is only for use on 115V and is equipped with an approved 3-conductor cord and 3-prong, grounding-type plug. To reduce the risk of electric shock, be certain that it is connected to a properly grounded, grounding-type receptacle. Do not modify or remove plug. Make sure pump circuit meets National Electrical Code. To avoid dangerous electrical shock hazard, keep cord dry at all times.

Models without cord and plug:

1. Connect ground wire first. Connect the ground first, then to green grounding terminal provided under motor canopy (see Figures 6 and 7) identified as GRD. Make ground connection to this terminal. **Do not** connect motor to electrical power supply until unit is permanently grounded; otherwise serious or fatal electrical shock hazard may be caused.
2. For best ground connection, connect to a grounded lead in the service panel or to a metal underground water pipe or well casing at least 10 ft. long. If plastic pipe or insulated fittings are used, run ground wire directly to the metal well casing or use ground electrode furnished by the power company.

TABLE II - RECOMMENDED FUSING AND WIRING

Motor Type	Motor H.P.	Volts/ Phase	Max. Load Amps	Branch Fuse Rating Amps	Wire Length		
					0'-100'	101-200'	201-300'
					AWG Wire Size		
ODP	1/2	115/230/1	12.4/ 6.2	20/15	12/14	10/14	8/14
ODP	1/2	230/460/3	3.1/1.55	15/15	14/14	14/14	14/14
ODP	3/4	115/230/1	14.8/7.4	20/15	12/14	8/14	6/14
ODP	3/4	230/460/3	3.6/1.8	15/15	14/14	14/14	14/14
ODP	1	115/230/1	19.2/9.6	25/15	10/14	8/14	6/12
ODP	1	230/460/3	4.7/2.35	15/15	14/14	14/14	14/14
ODP	1-1/2	115/230/1	24/12	30/15	10/14	6/12	6/12
ODP	1-1/2	230/1	12.0	15	14	14	12
ODP	1-1/2	230/460/3	6.8/3.4	15/15	14/14	14/14	14/14
ODP	2	115/230/1	26/13	35/20	8/12	6/12	4/10
ODP	2	230/1	10.4	15	14	14	14
ODP	2	230/460/3	6.0/3.0	15/15	14/14	14/14	14/14
ODP	3	208-230/1	15.0	20	12	12	10
ODP	3	200-230/460/3	11.5/5.8	15/15	14/14	14/14	12/14
TEFC	1	115/230/1	18/9	25/15	10/14	8/14	8/12
TEFC	1	208-230/460/3	4.8/2.4	15/15	14/14	14/14	14/14
TEFC	1-1/2	230/1	10.4	15	14	14	12
TEFC	1-1/2	208-230/460/3	6.0/3.0	15/15	14/14	14/14	14/14
TEFC	2	230/1	11.7	15	14	10	8
TEFC	2	208-230/460/3	7.0/3.5	15/15	14/14	14/14	14/14
TEFC	3	230/1					
TEFC	3	208-230/460/3	7.0/3.5	15/15	14/14	14/14	14/14

MAINTENANCE

Pump Disassembly

⚠ WARNING Hazardous voltage. Can shock, burn or cause death. Disconnect power to pump before servicing.

Tools required:

1. 7/16" open end wrench (2 required).
2. Flat blade screwdriver with insulated handle.
3. Work bench with vise recommended.
4. Pliers or similar tool.
5. Pipe wrench.

Impeller Stack Changeout (See Figure 8)

Remove pump from service and mount vertically in vise (if available) motor side down. Hold at center of motor. It may be desirable to wrap motor with a shop rag to protect outside surface.

Proceed as follows:

1. Attach pipe wrench to flats on discharge connection and turn clockwise to remove (left hand threads).
2. Remove screws holding motor canopy and remove canopy. Pull straight off as shown. Leave switch wires attached (if present).

⚠ WARNING Capacitor voltage may be hazardous. To discharge capacitor, hold insulated handle

screwdriver **by the handle** and short capacitor terminals together. Do not touch metal screwdriver blade or capacitor terminals.

3. Unscrew the overload and move it aside. Do not disconnect wires. Slide 7/16" open end wrench in behind spring loaded centrifugal switch as shown. Place on motor shaft flats to hold shaft stationary.
4. With one 7/16" wrench in place on motor shaft, place second wrench on shaft hex at pump end and unscrew impeller stack by turning counter-clockwise.
5. Once loose from motor shaft, hold shaft by snap ring using a pliers or similar tool, and pull stack from shell. You may have to apply a back and forth motion to break stack loose from shell.

To assemble with replacement impeller stack, keep pump in the vertical position, motor down, and reverse instructions 1 through 5.

Assembly hints:

- A. Apply a soapy water solution to suction and discharge O-Rings to ease seating of shell.
- B. Make sure mechanical shaft seal spring is in proper position on motor shaft.
- C. On three-phase models, apply Loctite No. 271 to motor shaft threads before reinstalling stack.

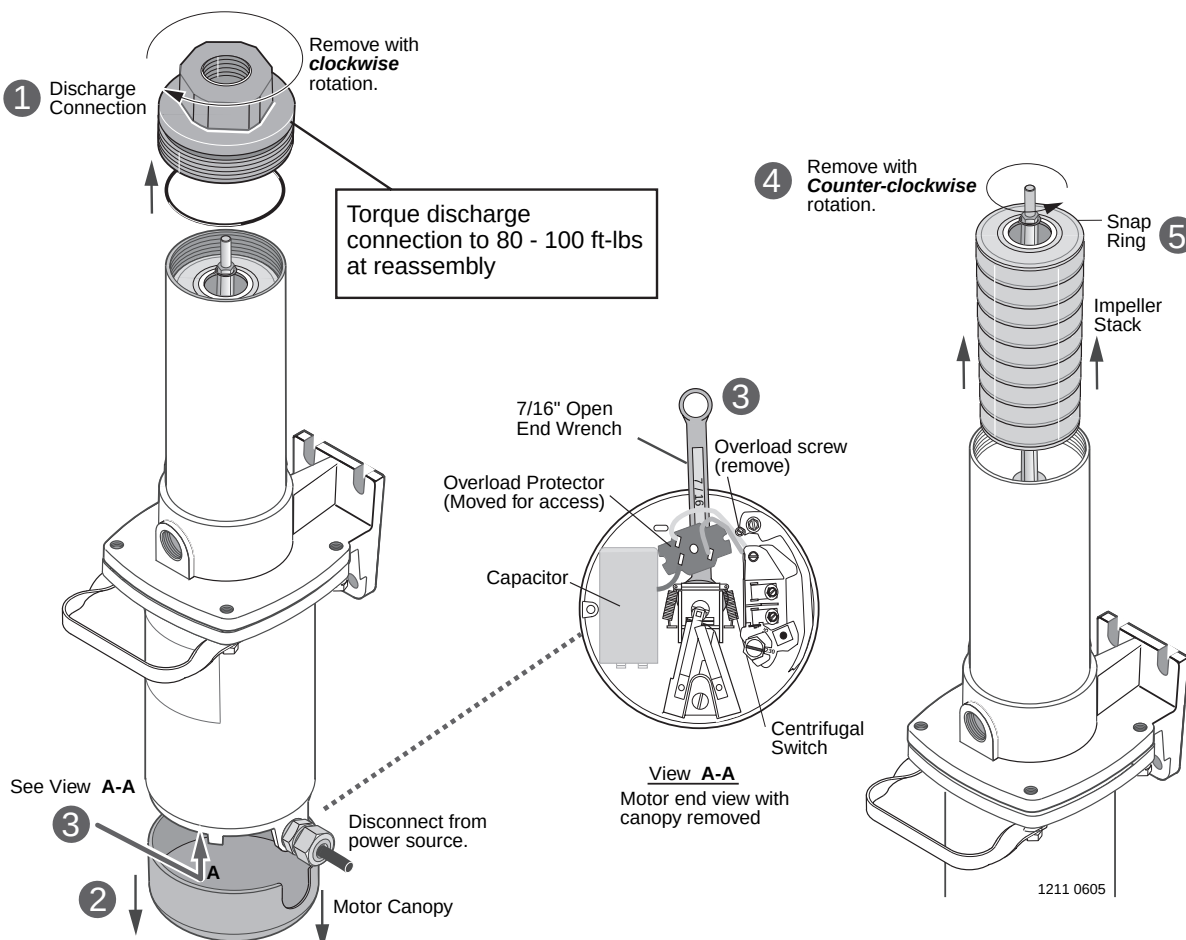


Figure 8 – Impeller stack changeout.

Mechanical Seal Changeout

(refer to Figures 8 and 9)

This procedure is best completed with the pump held in a vertical position, motor down.

First complete **"Disassembly"** instructions 1 through 5 under **"Impeller Stack Changeout."** (see Figure 8).

6. Remove 4 capscrews holding pump body to motor. Pump handle will come off with top capscrews.
7. Unscrew pump shell from pump body, turning clockwise (left hand threads).
8. Remove mechanical shaft seal spring and rotating half from motor shaft. Use care not to scratch motor shaft when removing rotating half.
9. Remove pump body from motor and place on flat surface, face down. Again, use care not to scratch motor shaft.
10. Use a screwdriver to push ceramic seat out from seal cavity as shown.

11. Installation of ceramic seat:

- A. Turn pump body over so seal cavity is up; clean cavity thoroughly.
- B. Clean polished surface of ceramic seat with a clean cloth.
- C. Lubricate outside rubber surface of seat with soapy water. Place cardboard washer over

polished face of seat and press into seal cavity using a 3/4" socket or a piece of 3/4" standard pipe.

- D. Be sure polished surface of seat is free of dirt and has not been damaged by insertion. Remove excess soapy water. Dispose of cardboard washer.

12. Installation of rotating half and spring:

- A. Reinstall pump body on motor using extreme caution not to hit ceramic portion of seal on motor shaft. Reattach pump body to motor using capscrews. Be sure to reinstall pump handle at this time.
- B. Inspect shaft to make sure that it is clean.
- C. Clean face of rotating half of seal with a clean cloth.
- D. Lubricate inside diameter of rotating half with soapy water and slide onto motor shaft (sealing face first).
- E. Place spring over motor shaft so it rests on rotating half.

13. To complete reassembly from this point, reverse instructions 1 through 5 under **"Impeller Stack Changeout."**

NOTICE: Lubricate suction and discharge O-Rings with soapy water for easier installation of shell.

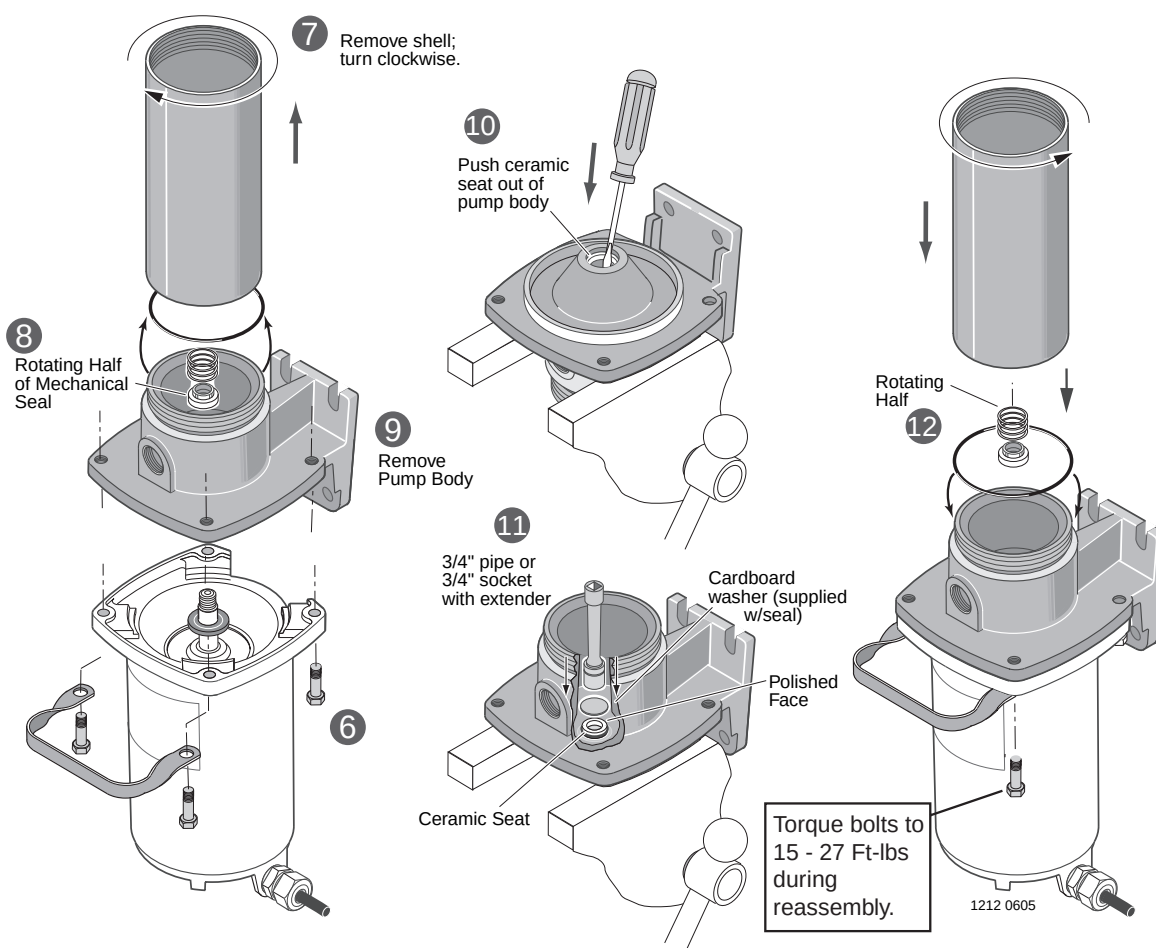


Figure 9 – Mechanical seal changeout.

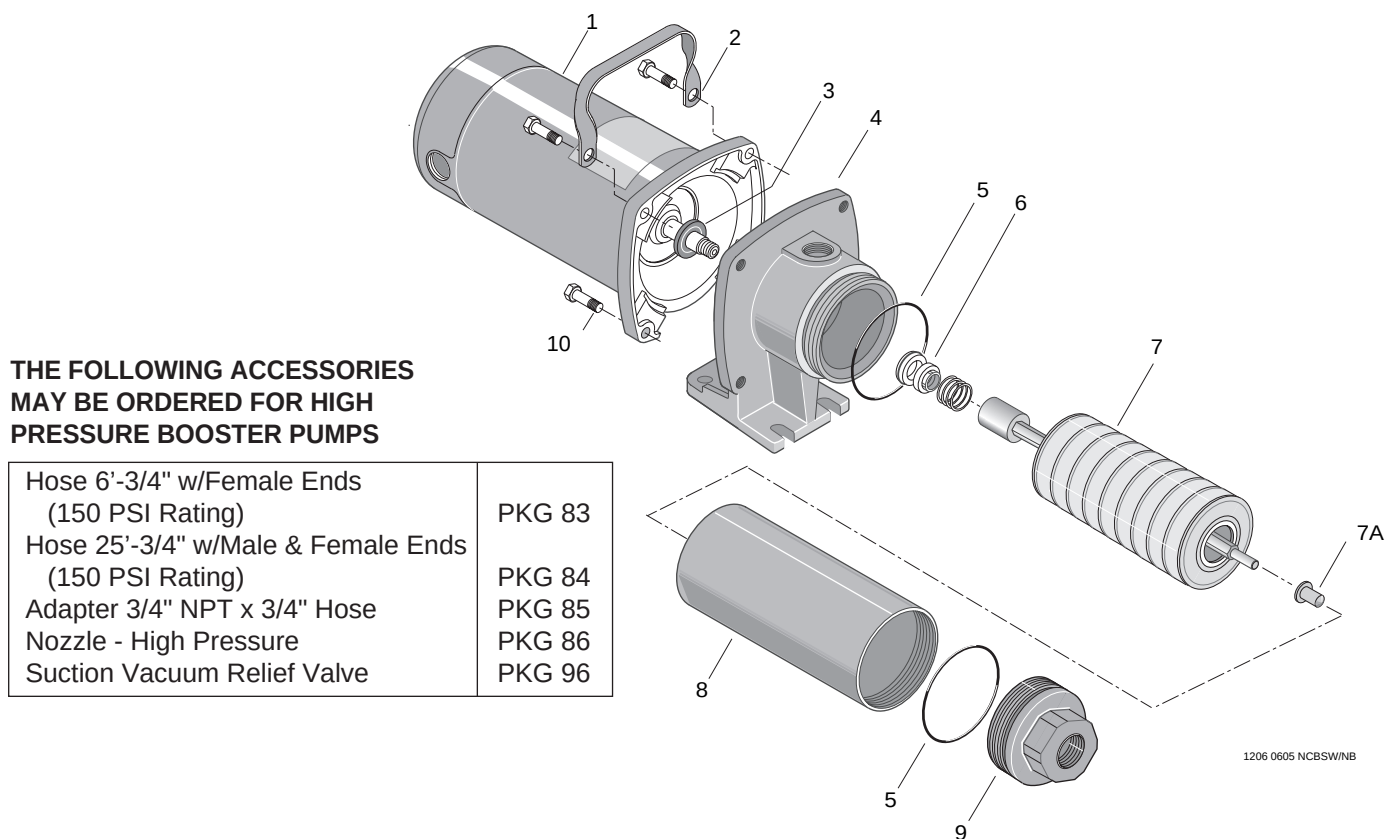


Figure 9 – Exploded view.

REPAIR PARTS LIST

Key No.	Description	Qty.	HP7C-02 HP7C3-02 HP10C-02 HP10C3-02 1/2 HP	HP7D-02 HP7D3-02 HP10D-02 HP10D3-02 3/4 HP	HP7E-02 HP7E3-02 HP10E-02 HP10E3-02 HP10E311-02 1 HP	HP10F-02 HP10F3-02 1-1/2 HP	SHP10G3-02 HP10G-02 HP10G3-02 2 HP
1	Motor - 115/230 Volt, 1 Phase	1	J218-590PKG	J218-596PKG	J218-601PKG	J218-883APKG	J218-628APKG
1	Motor - 230/460 Volt, 3 Phase	1	AP100CH	AP100DL2	AP100EH	AP100FH	AP100GH
2	Handle (†)	1	C54-21	C54-21	C54-21	—	—
3	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009
4	Pump Body	1	C2-85	C2-85	C2-85	C2-85	C2-85
5	O-Ring	2	U9-430	U9-430	U9-430	U9-430	U9-430
6	Shaft Seal Assembly	1	U109-118	U109-118	U109-118	U109-118	U109-118
7	Pump Stack (7 GPM Pump)	1	P325-422	P325-423	P325-424	—	—
7	Pump Stack (10 GPM Pump)††	1	P325-425	P325-426	P325-439	P325-428	P325-429
7A	Nylatron Bearing (included with Key No. 9)	1	W31112	W31112	W31112	W31112	W31112
8	Pump Shell (7 GPM Pump)	1	P56-430SSL	P56-431SSL	P56-432SSL	—	—
8	Pump Shell (10 GPM Pump)†††	1	P56-460SSL	P56-461SSL	P56-469SSL	P56-452SSL	P56-432SSL
9	Discharge Assembly	1	C152-3	C152-3	C152-3	C152-3	C152-4
10	Cap screw - 3/8 x 16 x 1-1/2"	4	U30-982ZP	U30-982ZP	U30-982ZP	U30-982ZP	U30-982ZP
#	Cord Connector**	1	U71-7	U71-7	—	—	—
#	Cord**	1	U17-402	U17-1238	—	—	—

Not Illustrated.

** Included with Model Numbers HP7C-01 and the HP7D Series Model Numbers.

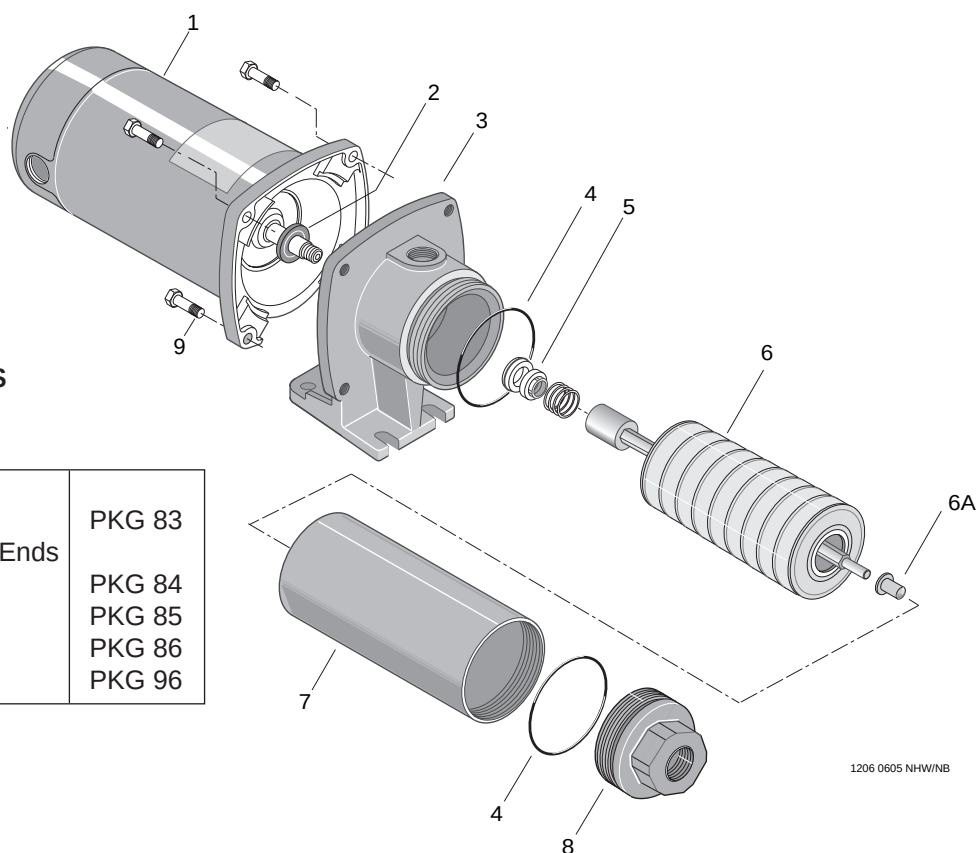
† Handle comes with HP7 series and HP10E series.

†† Model HP10E311-02 uses Part Number P325-362.

††† Model HP10E311-02 uses Part Number P56-404SSL.

**THE FOLLOWING ACCESSORIES
MAY BE ORDERED FOR HIGH
PRESSURE BOOSTER PUMPS**

Hose 6'-3/4" w/Female Ends (150 PSI Rating)	PKG 83
Hose 25'-3/4" w/Male & Female Ends (150 PSI Rating)	PKG 84
Adapter 3/4" NPT x 3/4" Hose	PKG 85
Nozzle - High Pressure	PKG 86
Suction Vacuum Relief Valve	PKG 96



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Figure 10 – Exploded view.

REPAIR PARTS LIST

Key No.	Description	Qty.	HPS7C-01 HPS7C3-01 HPS10C-01 HPS10C3-01 1/2 HP	HPS7D-01 HPS7D3-01 HPS10D-01 HPS10D3-01 3/4 HP	HPS7E-01 HPS7E3-01 HPS10E-01 HPS10E3-01 1HP	HPS10F-01 HPS10F3-01 1-1/2 HP	HPS10G-01 HPS10G3-01 2 HP
1	Motor - 115/230 Volt, 1 Phase	1	J218-590PKG	J218-596PKG	J218-601PKG	J218-883APKG	J218-628APKG
1	Motor - 230/460, 3 Phase	1	AP100CH	AP100DL2	AP100EH	AP100FH	AP100GH
2	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009	17351-0009
3	Pump Body	1	C2-86SS	C2-86SS	C2-86SS	C2-86SS	C2-86SS
4	O-Ring	2	U9-430	U9-430	U9-430	U9-430	U9-430
5	Shaft Seal Assembly	1	U109-118	U109-118	U109-118	U109-118	U109-118
6	Pump Stack (7 GPM)	1	P325-422R	P325-423R	P325-424R	—	—
6	Pump Stack (10 GPM)	1	P325-425R	P325-426R	P325-439R	P325-428R	P325-429R
6A	Nylatron Bearing (included with Key No. 9)	1	W31112	W31112	W31112	W31112	W31112
7	Pump Shell (7GPM)	1	P56-430SSL	P56-431SSL	P56-432SSL	—	—
7	Pump Shell (10GPM)	1	P56-460SSL	P56-461SSL	P56-469SSL	P56-452SSL	P56-432SSL
8	Discharge Assembly	1	C152-4	C152-4	C152-4	C152-4	C152-4
9	Capscrew 3/8 x 16 x 1-1/2", S.S.	4	S25983	S25983	S25983	S25983	S25983

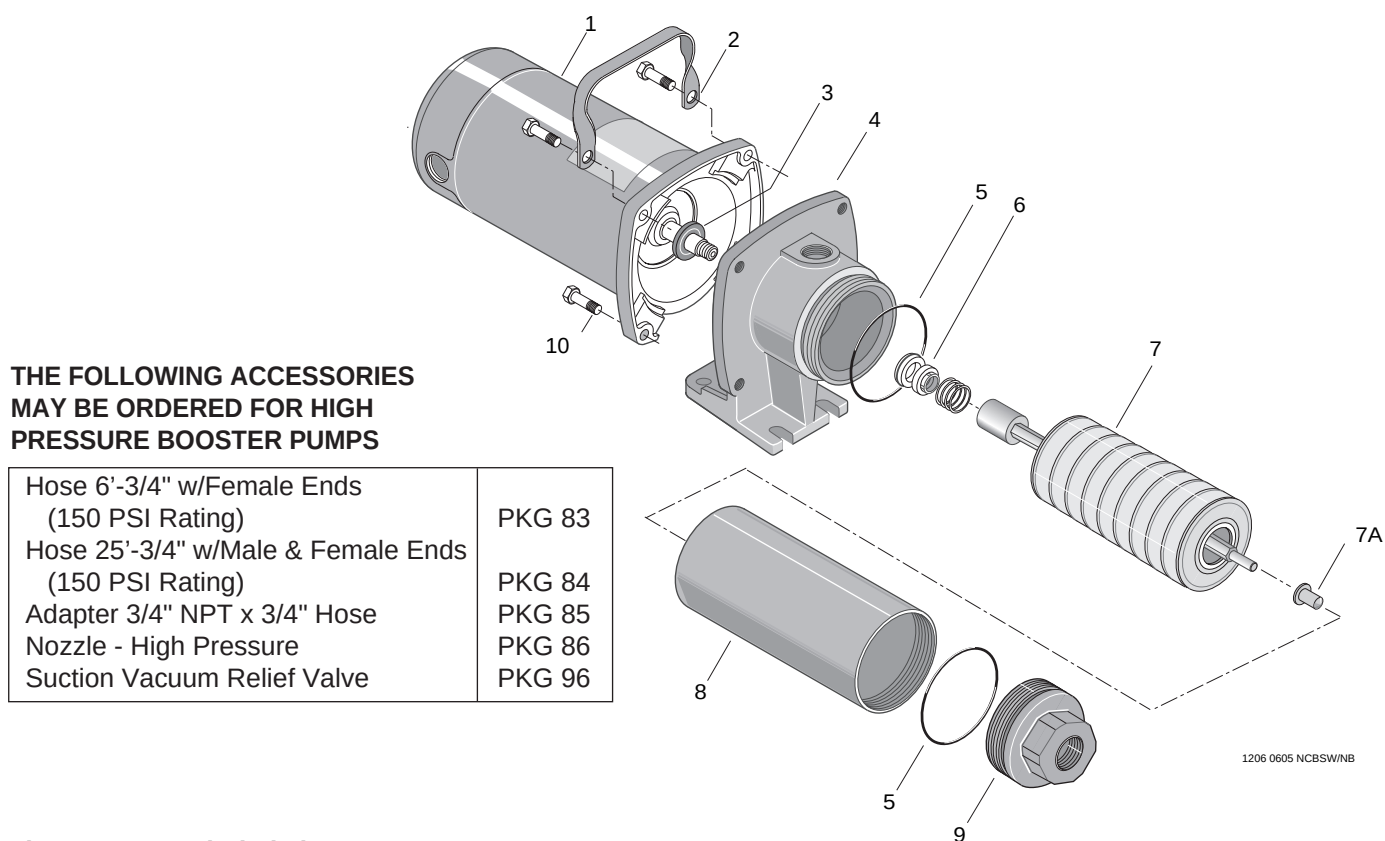


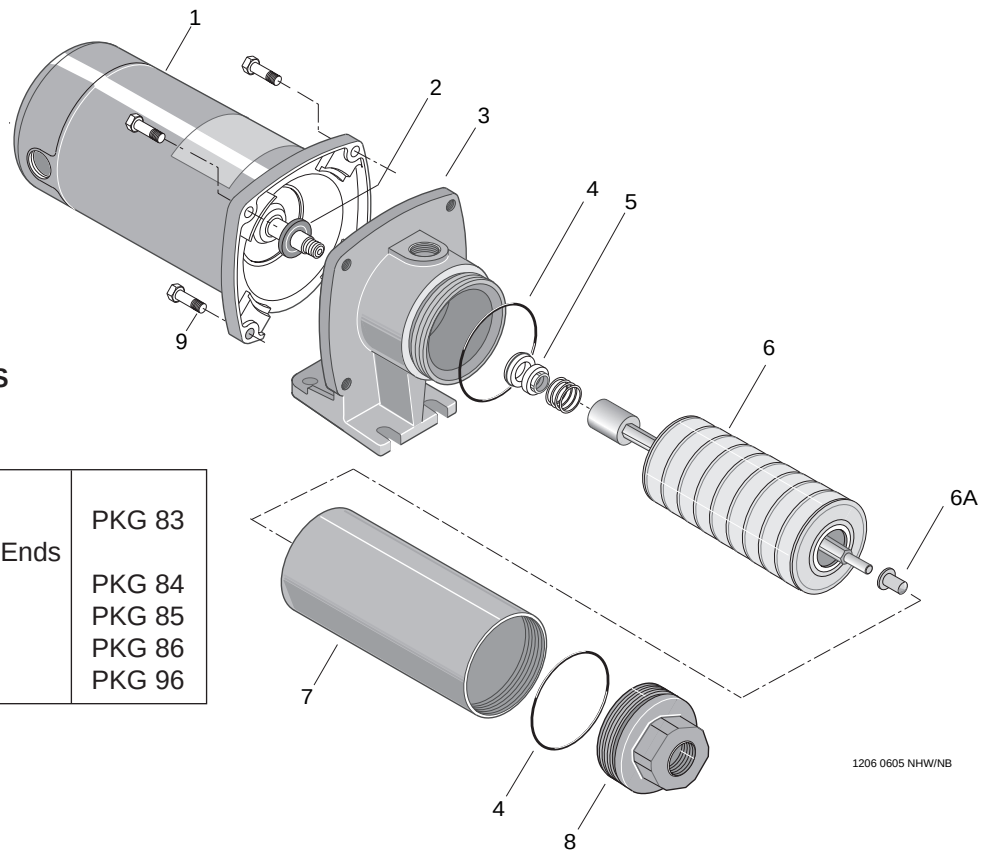
Figure 11 – Exploded view.

REPAIR PARTS LIST

Key No.	Description	Qty.	HP20E-02 HP20E3-02 1 HP	HP20F-02 HP20F3-02 1-1/2 HP	HP20G-02 HP20G3-02 2 HP	HP20H-01 HP20H3-01 HP20HT-02 HP20H3T-02 3 HP
1	Motor - 115/230 Volt, 1 Phase	1	J218-601PKG	J218-883APKG	J218-628APKG	—
1	Motor - 230 Volt, 1 Phase	1	—	—	A100GSL	AE100HLL
1	Motor - 230/460 Volt, 3 Phase	1	AP100EH	AP100FH	AP100GH	AP100HL
1	Motor - 230 Volt, 1 Phase, TEFC	1	—	—	—	J218-1035
1	Motor - 208-230/460 Volt, 3 Phase, TEFC	1	—	—	—	J218-1036
2	Handle	1	C54-21	C54-21	C54-21	C54-21
3	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009
4	Pump Body	1	C2-85A	C2-85A	C2-85A	C2-85A
5	O-Ring	2	U9-430	U9-430	U9-430	U9-430
6	Shaft Seal Assembly	1	U109-118	U109-118	U109-118	U109-118
7	Pump Stack	1	P325-602R	P325-431R	P325-432R	P325-718R
7A	Nylatron Bearing (included with Key No. 9)	1	W31112	W31112	W31112	W31112
8	Pump Shell	1	P56-433SSL	P56-434SSL	P56-452SSL	P56-620SSL
9	Discharge Assembly	1	C152-3A	C152-3A	C152-3A	C152-3A
10	Capscrew - 3/8 x 16 x 1-1/2"	4	U30-982ZP	U30-982ZP	U30-982ZP	U30-982ZP

**THE FOLLOWING ACCESSORIES
MAY BE ORDERED FOR HIGH
PRESSURE BOOSTER PUMPS**

Hose 6'-3/4" w/Female Ends (150 PSI Rating)	PKG 83
Hose 25'-3/4" w/Male & Female Ends (150 PSI Rating)	PKG 84
Adapter 3/4" NPT x 3/4" Hose	PKG 85
Nozzle - High Pressure	PKG 86
Suction Vacuum Relief Valve	PKG 96



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Figure 12 – Exploded view.

REPAIR PARTS LIST

Key No.	Description	Qty.	HPS20E-01 HPS20E3-01 1HP	HPS20F-01 HPS20F3-01 1-1/2 HP	HPS20G-01 HPS20G3-01 2 HP	HPS20H-01 HPS20H3-0 HPS20HT-01 HPS20H3T-01 3 HP
1	Motor - 115/230 Volt, 1 Phase	1	J218-601PKG	J218-883APKG	J218-628APKG	—
1	Motor - 230 Volt, 1 Phase	1	—	—	A100GSL	AE100HLL
1	Motor - 230/460 Volt, 3 Phase	1	AP100EL2	AP100FH	AP100GH	AP100HL
1	Motor - 230 Volt, 1 Phase, TEFC	1	—	—	—	J218-1035
1	Motor - 208-230/460 Volt, 3 Phase, TEFC	1	—	—	—	J218-1036
2	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009
3	Pump Body	1	C2-86SSA	C2-86SSA	C2-86SSA	C2-86SSA
4	O-Ring	2	U9-430	U9-430	U9-430	U9-430
5	Shaft Seal Assembly	1	U109-118	U109-118	U109-118	U109-118
6	Pump Stack	1	P325-440R	P325-431R	P325-432R	P325-718R
6A	Nylatron Bearing (included with Key No. 8)	1	W31112	W31112	W31112	W31112
7	Pump Shell	1	P56-470SSL	P56-434SSL	P56-452SSL	P56-620SSL
8	Discharge Assembly	1	C152-4A	C152-4A	C152-4A	C152-4A
9	Capscrew 3/8 x 16 x 1-1/2"	4	S25983	S25983	S25983	S25983

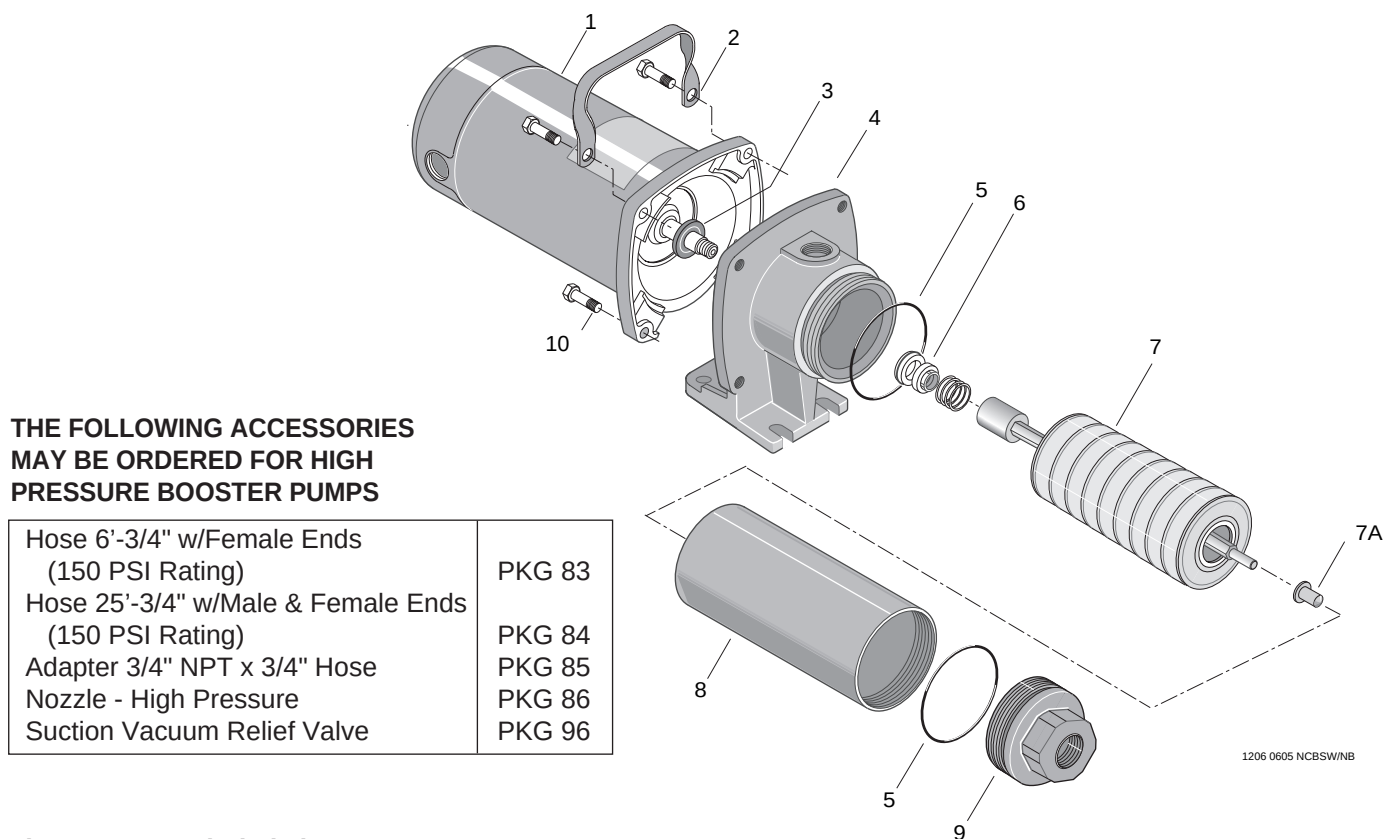


Figure 13 – Exploded view.

REPAIR PARTS LIST

Key No.	Description	Qty.	HP30E-02 HP30E3-02 HP30ET-02 HP30E3T-02 1 HP	HP30F-02 HP30F3-02 HP30FT-02 HP30F3T-02 1-1/2 HP	HP30G-02 HP30G3-02 HP30GT-02 HP30G3T-02 2 HP	HP30H-02 HP30H3-02 HP30HT-02 HP30H3T-02 3 HP
1	Motor - 115/230 Volt, 1 Phase	1	J218-601PKG	J218-883APKG	J218-628APKG	—
1	Motor - 230 Volt, 1 Phase	1	—	—	A100GSL	AE100HLL
1	Motor - 230/460 Volt, 3 Phase	1	AP100EH	AP100FH	AP100GH	AP100HL
1	Motor - 230 Volt, 1 Phase, TEFC	1	A100FL-T	AE100GL-T	AE100G5L-T	J218-1035
1	Motor - 208-230/460 Volt, 3 Phase, TEFC	1	AP100FL-T	AP100GL-T	AP100G5L-T	J218-1036
2	Handle	1	C54-21	C54-21	C54-21	C54-21
3	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009
4	Pump Body	1	C2-85B	C2-85B	C2-85B	C2-85B
5	O-Ring	2	U9-430	U9-430	U9-430	U9-430
6	Shaft Seal Assembly	1	U109-118	U109-118	U109-118	U109-118
7	Pump Stack	1	P325-719R	P325-720R	P325-721R	P325-722
7A	Nylatron Bearing (included with Key No. 9)	1	W31112	W31112	W31112	W31112
8	Pump Shell	1	P56-621SSL	P56-622SSL	P56-434SSL	P56-615SSL
9	Discharge Assembly	1	C152-3B	C152-3B	C152-3B	C152-3B
10	Capscrew - 3/8 x 16 x 1-1/2"	4	U30-982ZP	U30-982ZP	U30-982ZP	U30-982ZP

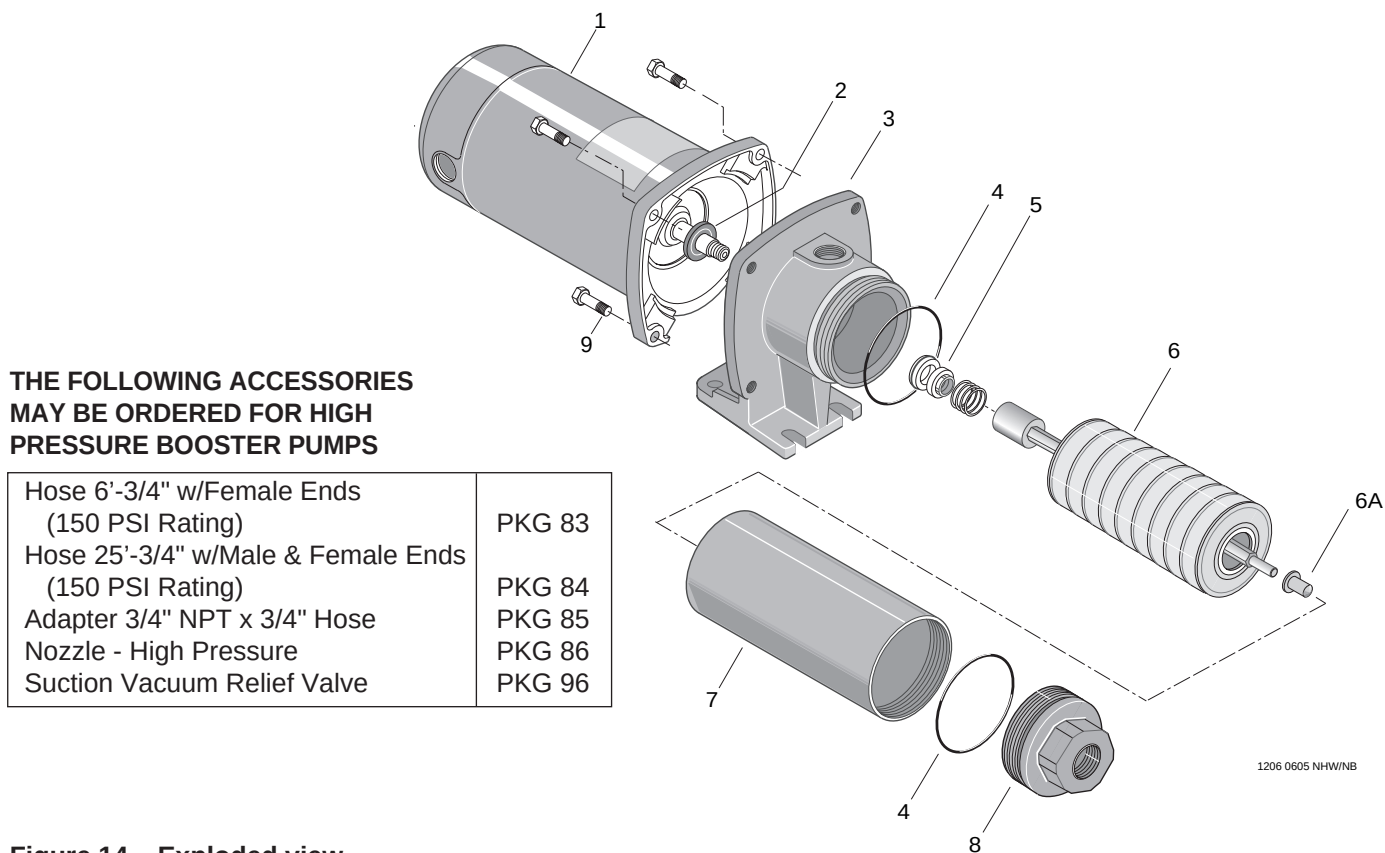


Figure 14 – Exploded view.

REPAIR PARTS LIST

Key No.	Description	Qty.	HPS30E-01 HPS30E3-0 HPS30ET-01 HPS30E3T-01 1HP	HPS30F-01 HPS30F3-01 HPS30FT-01 HPS30F3T-01 1-1/2 HP	HPS30G-01 HPS30G3-01 HPS30GT-01 HPS30G3T-01 2 HP	HPS30H-01 HPS30H3-01 HPS30HT-01 HPS30H3T-01 3 HP
1	Motor - 115/230 Volt, 1 Phase	1	J218-601PKG	J218-883APKG	J218-628APKG	—
1	Motor - 230 Volt, 1 Phase	1	—	—	A100GSL	AE100HLL
1	Motor - 230/460 Volt, 3 Phase	1	AP100EH	AP100FH	AP100GH	AP100H
1	Motor - 230 Volt, 1 Phase, TEFC	1	A100FL-T	AE100GL-T	AE100G5L-T	J218-1035
1	Motor - 208230/460 Volt, 3 Phase, TEFC	1	AP100FL-T	AP100GL-T	AP100G5L-T	J218-1036
2	Water Slinger	1	17351-0009	17351-0009	17351-0009	17351-0009
3	Pump Body	1	C2-86SSB	C2-86SSB	C2-86SSB	C2-86SSB
4	O-Ring	2	U9-430	U9-430	U9-430	U9-430
5	Shaft Seal Assembly	1	U109-118	U109-118	U109-118	U109-118
6	Pump Stack	1	P325-719R	P325-720R	P325-721R	P325-722R
6A	Nylatron Bearing (included with Key No. 9)	1	W31112	W31112	W31112	W31112
7	Pump Shell	1	P56-621SSL	P56-622SSL	P56-434SSL	P56-615SSL
8	Discharge Assembly	1	C152-4B	C152-4B	C152-4B	C152-4B
9	Capscrew 3/8 x 16 x 1-1/2"	4	S25983	S25983	S25983	S25983

LIMITED WARRANTY

Sta-Rite Industries, warrants to the original consumer of the products listed below, that they will be free from defects in material and workmanship for the Warranty Period from the date of original installation or manufacture as noted.

Product	Warranty Period
Water Systems Products – jet pumps, small centrifugal pumps, submersible pumps and related accessories	<i>whichever occurs first:</i> 1 year from date of original installation, or 2 years from date of manufacture
Hydro-Flow Filters	1 year from date of purchase
Signature 2000® Fibrewound Tanks	5 years from date of original installation
Pro-Source™ Steel Pressure Tanks	5 years from date of original installation
Pro-Source™ Epoxy-Lined Tanks	3 years from date of original installation
Sump/Sewage/Effluent Products	1 year from date of original installation, or 2 years from date of manufacture

Our warranty will not apply to any product that has been subject to negligence, misapplication, improper installation or maintenance. In the event a three phase submersible motor is operated with single phase power through a phase converter, or if three-leg ambient compensated, extra-quick trip overload relays of recommended size are not used, our warranty is void.

Buyer's only remedy and Sta-Rite Industries' only duty is to repair or replace defective products (at Sta-Rite Industries' choice). Buyer agrees to pay all labor and shipping charges associated with this warranty and to request warranty service through the installing dealer as soon as a problem is discovered. If warranty service is requested more than 30 days after the Warranty Period has ended, it will not be honored.

STA-RITE INDUSTRIES SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, OR CONTINGENT DAMAGES WHATSOEVER.

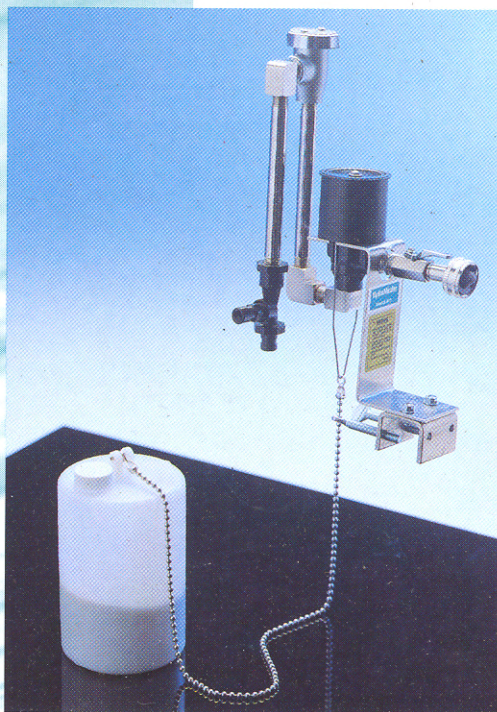
THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS WARRANTIES. IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, SHALL NOT EXTEND BEYOND THE WARRANTY PERIOD PROVIDED HEREIN.

Certain states do not permit the exclusion or limitation of incidental or consequential damages or the placing of limitations on the duration of an implied warranty, therefore, the limitations or exclusions herein may not apply. This warranty sets forth specific legal rights and obligations, however, additional rights may exist, which may vary from state to state.

Supersedes all previous publications.

Sta-Rite Industries, 293 Wright St., Delavan, WI 53115

HydroMinder Series



Model 511

Keep any reservoir filled with consistently mixed solution without pouring, stirring, waiting or downtime. When the solution level in a reservoir drops, the HydroMinder's float opens a non-electric, magnetic valve. The flow of water siphons liquid concentrate into the water stream, automatically maintaining the level of ready-to-use solution. (Models are available for maintaining a tank of plain water, too.) When the tank reaches the preset fill level, the HydroMinder shuts off. This mechanism has been working in the field for over 20 years. That's why HydroMinders have become the industry standard for liquid level maintenance.

Saves time & money, enhances safety & performance

Because the HydroMinder eliminates the need for manually handling, measuring and mixing concentrated chemicals, it saves labor time. It's also more accurate than manual mixing, so it reduces costly rework that can result from solutions that are too strong or too weak. Products which are properly diluted work better, too. The automatic mixing of concentrated products with water enhances safety by minimizing employee exposure to the concentrated

products. HydroMinders are made of highly durable materials for maximum life and serviceability, so maintenance time required is kept to a minimum.

Environmentally friendly

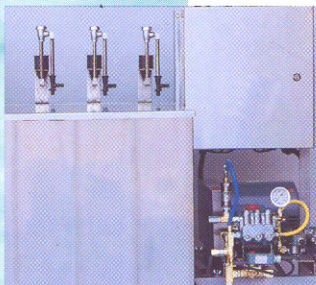
HydroMinders allow easy use of concentrated products. Concentrated products last longer than an equal amount of ready-to-use products, so concentrates reduce solid waste packaging that must be thrown away. Accidental spills are less likely since employees handle the concentrate containers less. Electricity is conserved because HydroMinders are operated by water flow only.

Useful in a variety of applications

There are many situations that call for solutions to be held at the ready for use on demand. Here are just a few:

- | | |
|---|--------------------------------|
| ▲ automatic or self-serve vehicle washing systems | ▲ central cleaning systems |
| ▲ conveyor lubricating systems | ▲ water treatment systems |
| ▲ high pressure cleaning systems | ▲ spraying systems |
| ▲ machine tool cooling systems | ▲ metal finishing systems |
| ▲ parts washing machines | ▲ OEM cleaning systems |
| | ▲ high volume pumping systems. |

Low volume HydroMinders



Model 511

Model	Siphon	Mounting	Approximate Dilution Range		
	Breaker	Bracket	Max.	Min.	Flow Rate
506	NO	YES	240:1	4:1	4.5 GPM
507	NO	NO	240:1	4:1	4.5 GPM
511	YES	YES	240:1	4:1	4.5 GPM
5111	YES**	YES	240:1	4:1	4-5.6 GPM
512	YES	NO	240:1	4:1	4.5 GPM
515	YES	YES	100:1	1:1	1.5 GPM
532*	YES	YES	195:1	3:1	2 @ 6 GPM

* Model 532 has two independent eductors which meter two concentrates at their individually required dilution ratios, or one concentrate at two different ratios.

** Backflow prevention provided by Hydro's e-gap eductor

Medium volume HydroMinders

Model	Siphon	Mounting	Approximate Dilution Range		
	Breaker	Bracket	Max.	Min.	Flow Rate
525	NO	YES	530:1	4:1	9 GPM
530	YES	YES	530:1	4:1	9 GPM
561	NO	YES	1200:1	6.5:1	18 GPM
562	YES	YES	1200:1	6.5:1	18 GPM

High volume HydroMinders

Model	Siphon	Mounting	Approximate Dilution Range		
	Breaker	Bracket	Max.	Min.	Flow Rate
563	YES	YES	1024:1	8:1	+25.0 GPM
564	NO	YES	1024:1	8:1	+25.0 GPM

HydroMinder water valves



Model 570

Model	Water Inlet	Mounting	Flow Rate
	Fittings	Bracket	
502	NO	YES	6.8 GPM
503	NO	NO	6.8 GPM
572	NO	YES	44.0 GPM
573	NO	NO	44.0 GPM

NOTE: All flow rates are approximate, based on water pressure of 40 PSI. Gallons per minute quoted in U.S. gallons.

HydroMinder water valves maintain tank levels of water only and do not provide any means for educting concentrate into the water stream.

Options and accessories

Model	Description
138	Water inlet hose, 1/2" x 6', black
139	Water inlet hose, 3/4" x 6', red
151	Dual concentrate retrofit kit; allows two concentrates to be proportioned using one HydroMinder via ball valve selection (both concentrates cannot be proportioned at the same time)
185	Water inlet hose, 1/2" x 8', black
186	Water inlet hose, 1/2" x 10', black

Hydro[®]
Systems

A DOVER COMPANY

3798 Round Bottom Rd., Cincinnati, OH 45244 USA ▲ Phone: 513-271-8800 ▲ Fax: 513-271-0160 ▲ Toll Free: 800-543-7184 ▲ www.hydro-systems.co.com © 2006

HydroNova Australia-NZ Unit 1, 35 Prime Drive, Seven Hills, Sydney, NSW 2147 Australia ▲ Phone: 011 612 9674 1700 ▲ Fax: 011 612 9674 7170

HydroMinder Model 506

Package Contains:

1. Proportioner with U-clamp for mounting
2. Float with chain
3. Suction tube with foot valve -- 9 ft.
4. Discharge tube -- 2 ft.
5. Metering tip kit (14 tips)
6. Production information sheet

THANK YOU FOR YOUR INTEREST IN OUR PRODUCTS

Please use this equipment carefully and observe all warnings and cautions.

***** NOTE *****

WEAR	protective clothing and eyewear when dispensing chemicals or other materials.
ALWAYS	observe safety and handling instructions of the chemical manufacturers.
ALWAYS	direct discharge away from you or other persons or into approved containers.
ALWAYS	dispense cleaners and chemicals in accordance with manufacturer's instructions. Exercise CAUTION when maintaining your equipment.
KEEP	equipment clean for proper operation.
WEAR	protective clothing and eyewear when working in the vicinity of all chemicals, filling or emptying equipment or changing metering tips.
ALWAYS	re-assemble equipment according to instruction procedures. Be sure all components are firmly screwed or latched into position.
ATTACH	only to tap water outlets (85 PSI maximum).

Through proper care and maintenance, this equipment will serve your toughest cleaning jobs.

Installation:

1. Select a metering tip (see next three sections) and insert it into the suction stub on the eductor body.
2. Attach the end of the discharge tube with the clamp and flooding ring to the discharge barb on the eductor. Since the HydroMinder 506 does not have a siphon breaker, you may want to drill a small hole (1/8" or 1/4" ID) in the discharge tube, above the highest solution level and below the discharge end of the eductor. This will allow the discharge tube to drain after each cycle.
3. Mount the unit in a level position on the side of the reservoir. The U-clamp may be repositioned or removed as necessary.
4. Insert the foot valve end of the suction tube into the concentrate container. (The level of the concentrate must be below the level of the eductor, or the proportioner will continue to siphon concentrate after it is turned "off".)
5. Slide the open end of the suction tube over the suction stub.
6. Adjust the bead chain length to position the float at the desired level of solution. To prevent foaming, be certain that the solution level will always be above the point of discharge. Be sure float mechanism is not hampered by water turbulence caused by discharging solution. It may be necessary to baffle the float from the discharge in order for the unit to work properly.
7. Install a minimum 1/2-inch ID water hose between the inlet threads and the water spigot. Minimum water pressure required to properly operate the proportioner is 25 PSI (flowing).

Measurement of Concentration:

You can determine the dispensed water-to-product ratio for any metering tip size and product viscosity. All that is required is to operate the primed dispenser for a minute or so and note two things: the amount of dispensed water/product mixture, and the amount of concentrate used in preparation of the solution dispensed. The water-to-product ratio is then calculated as follows:

$$\text{Dilution (X)} = \frac{\text{Amount of Mixed Solution} - \text{Amount of Concentrate Drawn}}{\text{Amount of Concentrate Drawn}}$$

Dilution ratio, then, equals X parts water to one part concentrate (X:1). If the test does not yield the desired ratio, choose a different tip and repeat the test. Alternative methods to this test are 1) pH (using litmus paper), and 2) titration. Contact your concentrate supplier for further information on these alternative methods and the materials required to perform them.

APPROXIMATE DILUTIONS AT 40 PSI FOR WATER-THIN PRODUCTS (1.0 CP)			
Tip Color	Orifice Size	(Std. Drill Number)	Ratio
No Tip	.187	(3/16)	4:1
Grey	.128	(30)	5:1
Black	.098	(40)	6:1
Beige	.070	(50)	8:1
Red	.052	(55)	17:1
White	.043	(57)	23:1
Blue	.040	(60)	25:1
Tan	.035	(65)	36:1
Green	.028	(70)	48:1
Orange	.025	(72)	64:1
Brown	.023	(74)	75:1
Yellow	.020	(76)	90:1
Purple	.014	(79)	120:1
Pink	.010	(87)	240:1

Metering Tip Selection:

The final concentration of the dispensed liquid is related to both the size of the metering tip opening (orifice) and the viscosity of the liquid being siphoned. If product viscosity is noticeably greater than that of water, consult the procedure for Measurement of Concentration on the first page to achieve your desired water-to-product ratio. For water-thin products, use the chart at right as a guideline. Because such factors as inlet water pressure and temperature can affect dilution ratios, the figures listed below are only approximate. Test the actual dilution you are achieving using the Measurement of Concentration procedure for best results. Two undrilled, clear tips are supplied for drilling sizes not listed.

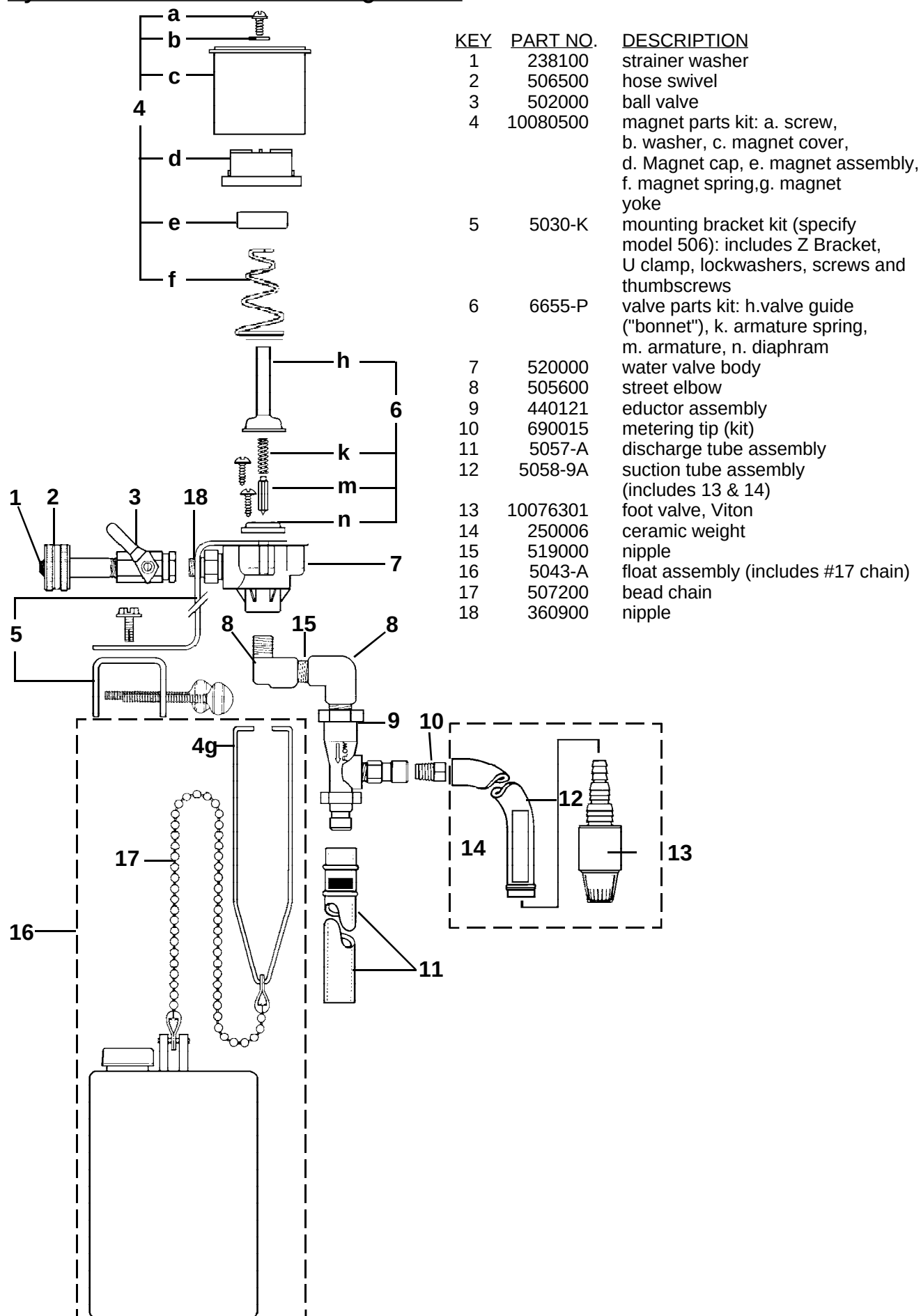
Operation:

Open the water supply ball valve. When the solution in the reservoir reaches the level set by the float, the valve will close. This will stop the water flow and siphoning of concentrate. When withdrawal of solution from the reservoir causes the level to drop more than 1-1/2 inches, the valve will open, and the reservoir will be refilled to the previous, pre-set level. This cycle will be repeated automatically until the supply of concentrate is depleted. The ball valve should be **fully closed** when changing metering tips or concentrate container, when reservoir is drained, or when the unit is not in use.

Troubleshooting:

Problem	Probable Cause	Remedy
1. No discharge	a. No water b. Defective magnetic valve assembly c. Excessive water pressure	a. Open water inlet b. Replace assembly c. Install regulator if pressure exceeds 85 PSI
2. No concentrate draw	a. Clogged foot valve b. Metering tip or eductor clogged c. Low water pressure d. Discharge tube or flooding ring not in place	a. Clean or replace foot valve b. Clean* or replace c. Minimum 25 PSI flowing required d. Check position: Replace discharge tube if flooding ring is missing.
3. Failure of unit to turn off	a. Valve parts dirty or defective b. Magnet spring too short c. Clogged valve orifice	a. Clean or replace b. Replace c. Clean or replace
4. Backflow into concentrate	a. Diluted solution being siphoned into container b. Water being siphoned into container	a. Replace or repair foot valve b. Replace eductor
* In hard water areas, scale may form at the discharge of the eductor. This scale may be removed by soaking the eductor in a descaling solution or by running the descaling solution through the system. If descaling solution is educted through the system, flush the unit by educting water only before returning the system to regular use.		

HydroMinder Model 506 Parts Diagram/List



MILLENIUM
INSTALLATION MANUAL
NTR 735 B/E
Simple Automation Control Module (MAS)

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1. Introduction

The MILLENIUM series has been designed for use in domestic, office and industrial applications. Each module can be used to manage all the sensors and actuators in the installation. A display on the front panel can be used to check the state of your system at any time.

The MILLENIUM series is characterised by :

- Ease of programming and parameter entry
- WINDOWS-based programming software
- Compact size
- EEPROM module backup
- Realtime clock as standard
- Output with high breaking capacity

The MILLENIUM series has been designed for simple automation control modules (examples : lighting, air conditioning, irrigation, doors, barriers, simple safety systems, greenhouses, ventilation). The realtime clock allows equipment to be programmed in hours or minutes.

2. Hardware description

2.1 Part numbers

Codes	Part numbers	Power supply	Inputs		Outputs		Dimensions mm	Weight kg
			Type	No.	Type	No.		
89 750 001	MAS 6 RCA	100 - 240V AC 24V DC	100 - 240V AC 24V DC	4	RELAY	2	71.2 x 90 x 55	0.2
89 750 002	MAS 10 RCA			6	RELAY	4		
89 750 003	MAS 10 RCD			6	RELAY	4		
89 750 013	MAS 10 TCD			6	TRANSISTOR	6		
89 750 004	MAS 20 RCA	100 - 240V AC 24V DC	100 - 240V AC 24V DC	12	RELAY	8	124.6 x 90 x 55	0.32*
89 750 005	MAS 20 RCD			12	RELAY	8		
89 750 015	MAS 20 TCD			12	TRANSISTOR	8		

2.2 Description of power supplies

Description	Code	Specification	
Power supply	MAS x RCA	100 - 240V AC, +10% -15%, 50/60 Hz	
	MAS x xCD	24V DC, +20% -15%	
Micro-cuts	MAS x RCA	10ms	
	MAS x xCD	5ms	
Current peak	240V AC	$\leq 1.5 \text{ A } t < 0.3 \text{ ms}$	
	24 V DC	$\leq 7 \text{ A } t < 0.2 \text{ ms}$	
Maximum consumption	MAS 6 RCA, 264V AC	3 VA	
	MAS 10 RCA, 264V AC	4 VA	
	MAS 10 RCD, 28,8V DC	3 W	
	MAS 10 TCD, 28,8V DC	2 W	
	*MAS 20 RCA, 264V AC	8 VA	
	*MAS 20 RCD, 28,8V DC	7 W	
	*MAS 20 TCD, 28,8V DC	5 W	
Typical consumption	MAS 6 RCA, 240V AC	Active I/O : 2.5 VA	Deactivated I/O : 1.5 VA
	MAS 6 RCA, 120V AC	Active I/O : 2 VA	Deactivated I/O : 1.2 VA
	MAS 10 RCA, 240V AC	Active I/O : 3 VA	Deactivated I/O : 1.5 VA
	MAS 10 RCA, 120V AC	Active I/O : 2.5 VA	Deactivated I/O : 1.2 VA
	MAS 10 RCD, 24V DC	Active I/O : 2 W	Deactivated I/O : 0.3 W
	MAS 10 TCD, 28,8V DC	Active I/O : 2 W	Deactivated I/O : 0.3 W
	*MAS 20 RCA, 240V AC	Active I/O : 5 VA	Deactivated I/O : 1.5 VA
	*MAS 20 RCA, 120V AC	Active I/O : 4 VA	Deactivated I/O : 1.2 VA
	*MAS 20 RCD, 24V DC	Active I/O : 5 W	Deactivated I/O : 0.3 W
	*MAS 20 TCD, 24V DC	Active I/O : 5 W	Deactivated I/O : 0.3 W

* Without special connection modules.

2.3 Description of inputs

Description	Description of AC inputs
Input voltage	100 - 240V AC, +10% -15%, 50/60 Hz
Input impedance	$\geq 800 \text{ k Ohms}$
Level 0	$\leq 40\text{V AC}$
Level 1	$\geq 80\text{V AC}$
Response time	25 ms min, 130 ms max.
Galvanic isolation	No
Status indication	LCD display

Description	Description of DC inputs
Input voltage	24V DC +20% -15%
Current consumption	5 mA
Level 0	$\leq 4\text{V}$
Level 1	$\geq 18\text{V}$
Response time	15 ms $\pm$ 5 ms (I 01 – I 08) 30 ms $\pm$ 10 ms (I 09 – I 12)
Galvanic isolation	No
Status indication	LCD display

Description	Description of analogue inputs
MAS 10 RCD	6 Inputs: I 01 – I 06
MAS 20 RCD	8 Inputs: I 01 – I 08
Number of bits	8
Resolution	(10000 / 250) mV
Conversion time	15 $\pm$ 5ms
Input voltage	0 – 10V DC
Input impedance	150 k Ohms max.
Precision	$\pm 5\%$
Default Offset/ Gain	Offset = 0 Gain = 1 These values can be changed by the program
Temp. dependent derating	$\pm 3 \text{ LSB}$ on the authorised range

2.4 Description of relay outputs

Description	Description of relay outputs
Max. operating voltage	250V AC, 30V DC
Max. operating current	8A / point
Minimum load	10mA at 5V DC
Response time	≤ 10ms
Type of contact	Gold-plated silver
Status indication	LCD display

Category of use	Max. operating voltage	Power consumption in steady state	Durability (number of operations)	Max. ops / hour
AC15 (electromagnet)	250V AC	450 VA	100 000	600
DC13 (electromagnet) (L/R = 150 ms)	30V DC	10 W	100 000	360
AC14 (electromagnet)	250V AC	750 VA	100 000	600
AC12 (resistive)	250V AC / 110V AC	2000 VA / 1100 VA	100 000 / 30 000	1800
DC12 (resistive)	30V DC	192 W	100 000	1800

2.5 Description of transistor outputs

Description	Description of transistor outputs
Operating voltage	5-24V DC (+ 20 % - 5 %)
Rating current / terminals	1 A / terminal (8-24V DC) 0.1A / terminal (5-8V DC)
Minimum load	1.0 mA
Max. inductive load	1 A / 24V DC (24 W)
Resistive load	0.125 A / 24V DC (3.0 W)
Response time Ton/Toff, Toff/Ton	≤ 1 ms
Open circuit current leakage	≤ 0.1 mA / 24 V DC
Status indication	LCD display
Isolation circuit	None

2.6 General description

Description	Specification
Programming	Logic block or function block
Program capacity	64 blocks or 1500 bytes
Program backup	Via internal EEPROM or optional external EEPROM module
Data backup	20 days at 25° C (via capacitor)
Clock backup	20 days at 25° C (via capacitor)
LCD display	Display unit with 4 lines of 10 characters.
Real time clock accuracy	5 seconds / day

Climatic conditions :

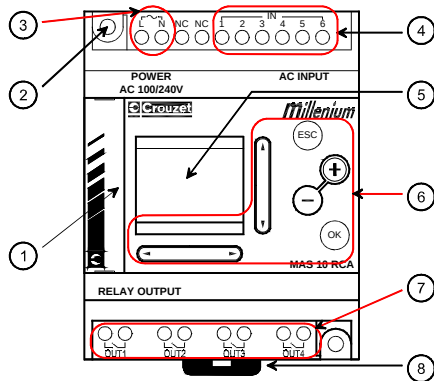
Type	Standard	Amplitude
Operating temperature		0/55 °C
Storage temperature		-30/70 °C
Humidity		35 - 85% relative humidity, without condensation
Degree of protection		IP 20
Environment		No corrosive gases. Minimum dust

Mechanical protection :

Type	IEC Standard	Amplitude
Resistance to vibrations Direct mounting	60068-2-6	10- 57 Hz: 0.15 mm Constant amplitude Acceleration 57- 150 Hz: 19.6 m/ s ² X, Y, Z : 10 times (80 minutes in each direction)
Resistance to vibrations Mounted on DIN rail	60068-2-6	10- 57 Hz: 0.075 mm Constant amplitude Acceleration 57- 150 Hz: 9.8 m/s ² X, Y, Z : 10 times (80 minutes in each direction)
Resistance to shocks	60068-2-27	Acceleration : 147m/s ² , duration: 11 ms X, Y, Z : 3 times in each direction

Type	Standard	Amplitude
Dielectric strength	EN 60730-1	3750V AC > 1 min between the following points : Power supply terminals / input / output terminals Between the relay outputs Between the terminals and the DIN 43880 control box or equivalent
Insulation resistance	EN 60730-1	7 Mohm at 500V DC between the following points : Power supply terminals / input / output terminals Between the relay outputs Between the terminals and the DIN 43880 control box or equivalent
Safety class		II
Certifications		CE Low Voltage directive 73/23/EEC EMC directive 89/336/EEC UL/ cUL
Conformity	UL 508 EN60730- 1 EN61010- 1 EN50081- 1 EN50082- 1 EN50082- 2	

3. Installation



Ref.	Description of front panel
1	Programming port EEPROM backup module
2	Fixing holes, Ø : 4.2 mm
3	Power supply terminals
4	Input terminals
5	LCD display
6	Menu keys
7	Output terminals
8	DIN rail mounting

3.1 DIN rail mounting

The modules can be mounted on a 35 mm DIN rail (DIN EN 50022).

3.2 Panel mounting

Recommended diameter of fixing screws : M4.

3.3 Screw terminal connection

The end of the wire should be fitted with a ferrule.

3.4 Mounting instructions



The MILLENIUM series can be installed anywhere, but the following points should be taken into consideration.

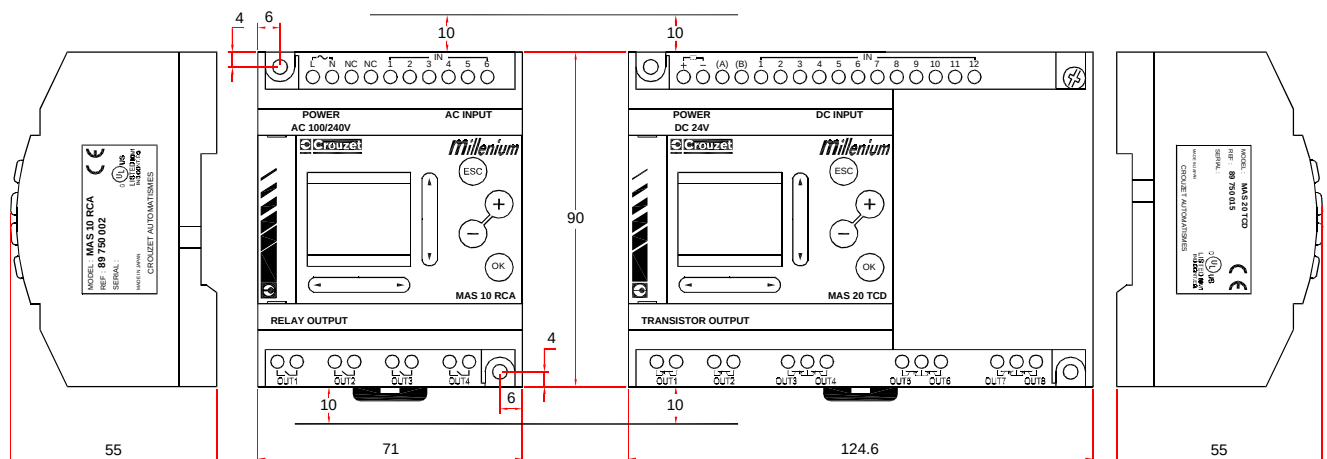
Do not install if : the atmosphere is excessively dusty, conductive, corrosive, gas-laden, damp, wet or inflammable, or subject to excessive heat*, excessive shocks or vibrations.

Do not install the module in water or near any possible leaks.

Protect the module from external debris during installation.

Separate the cables and power equipment as far as possible. The MILLENIUM series module should be installed in cabinets which adhere to standard DIN 43880.

- For sufficient module ventilation, allow a space of 10 mm between the front of the module and the cabinet door, and likewise between the base of the cabinet and the bottom of the module.



4. Connection

4.1 Connection instructions



The MILLENIUM series has been designed with ease of connection in mind. A technician or engineer with experience of national and local electrical standards should be able to connect MILLENIUM series modules to the sensors and actuators without difficulty.

- The input and output cables should not be in the same wiring harness.
- Keep the input/output wiring harnesses well away from the power wiring harnesses.
- Use cables which are suitable for the application.

4.2 Conductor cross-section



For the inputs / outputs use conductors : 0.13 mm² - 3.31 mm² (26 - 12 AWG).

Strip back the conductor by 7 ± 0.5 mm.

Undo the terminal screw to its maximum before inserting a conductor.

To be sure of correct connection, insert the wire fully in the terminal and tighten the screws.

Maximum tightening torque 0.5 Nm (5kgfcm).

Do not coat the conductor ends with tin to prevent them breaking.

4.3 Power supply

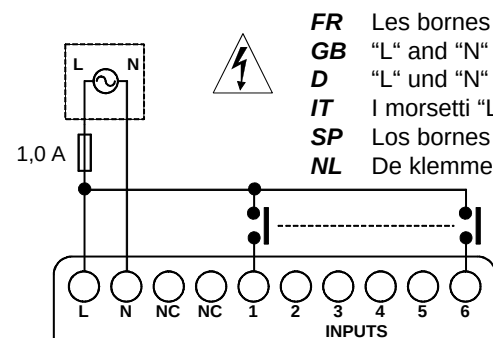
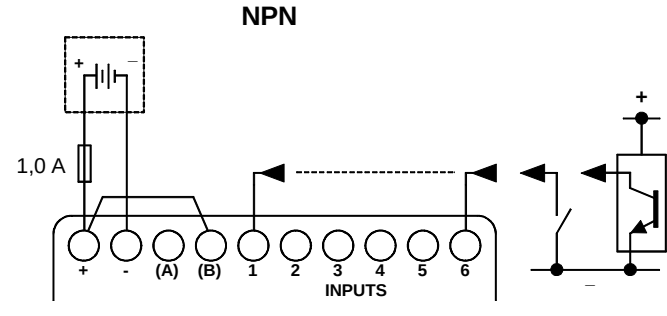
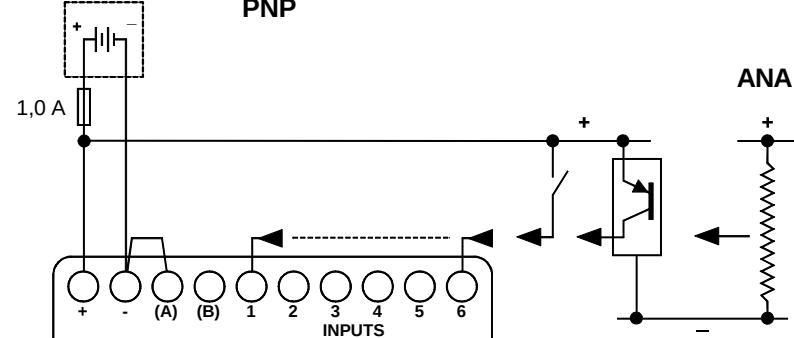
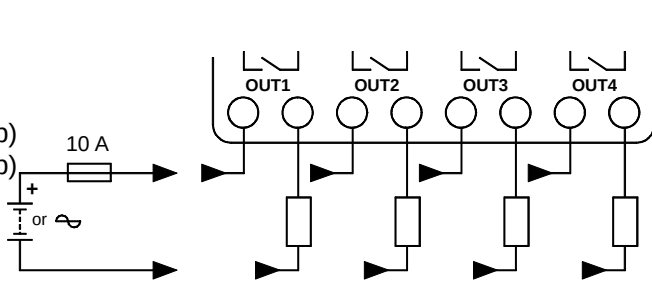
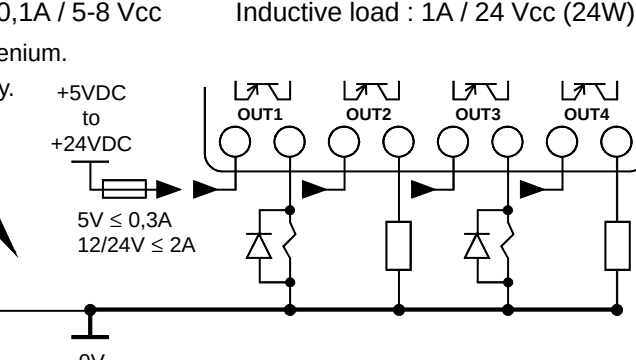


For an AC power supply, the phase should be connected to the L terminal and the Neutral to the N terminal. Never connect the phase to the N terminal, as the user could receive a dangerous electric shock.

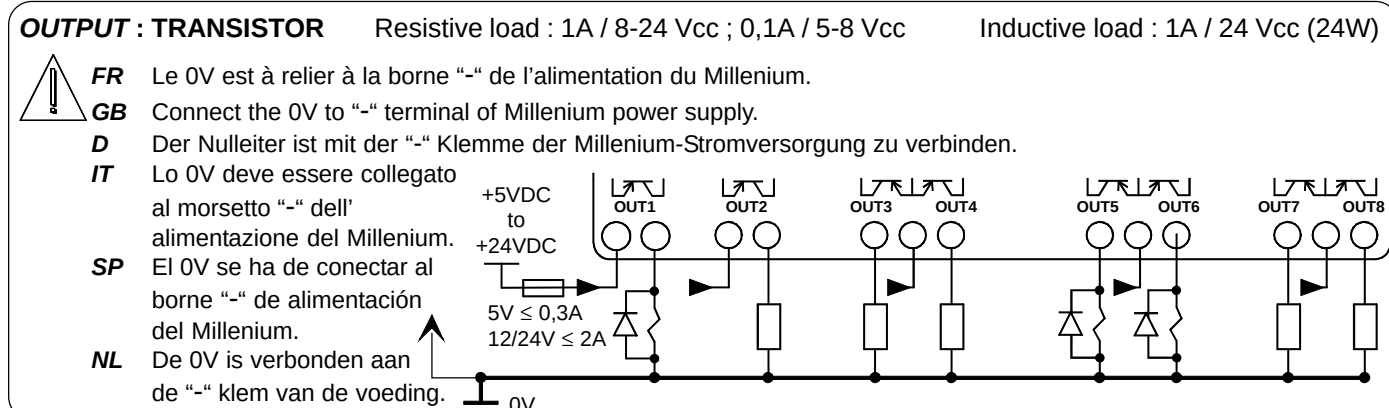
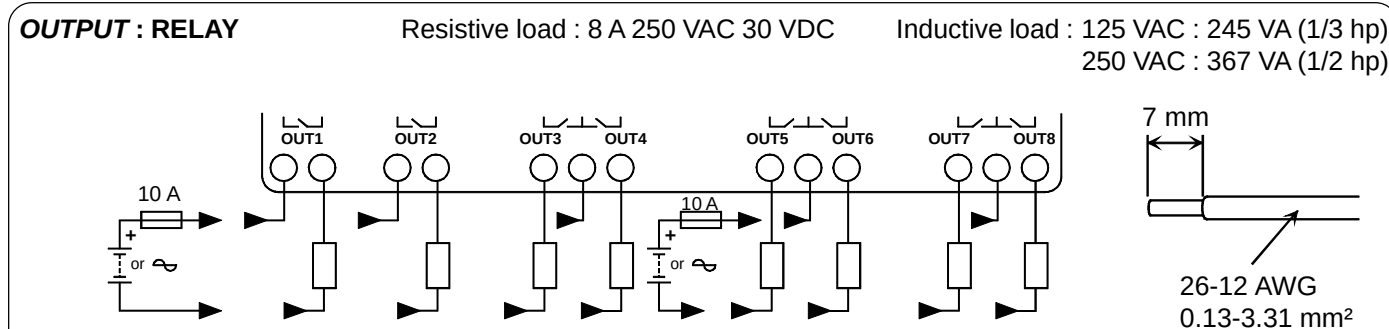
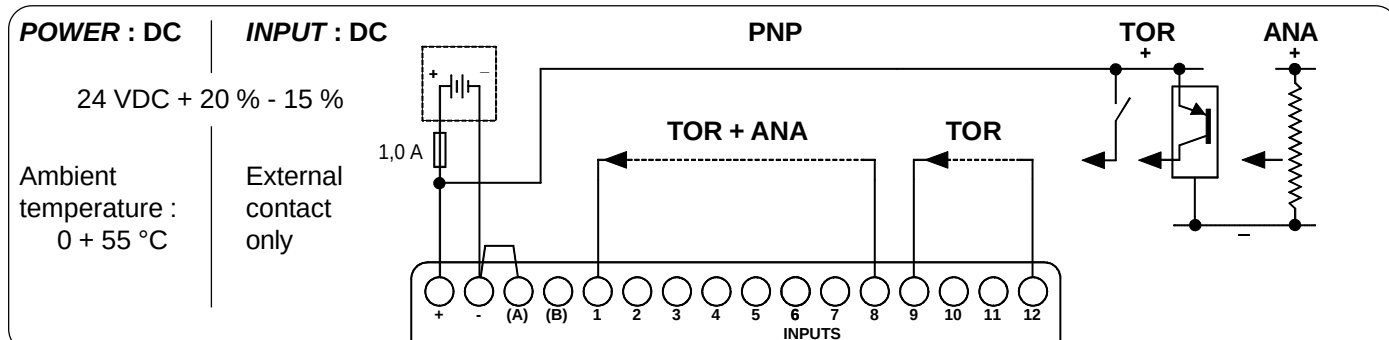
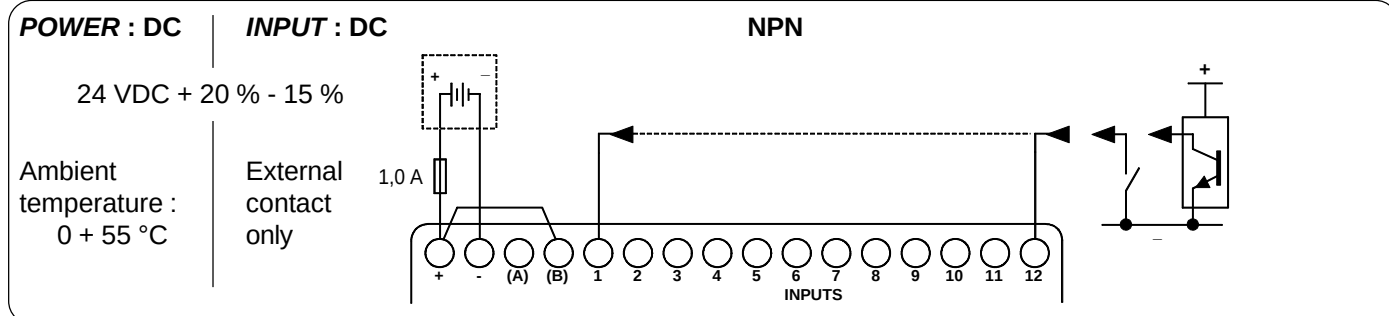
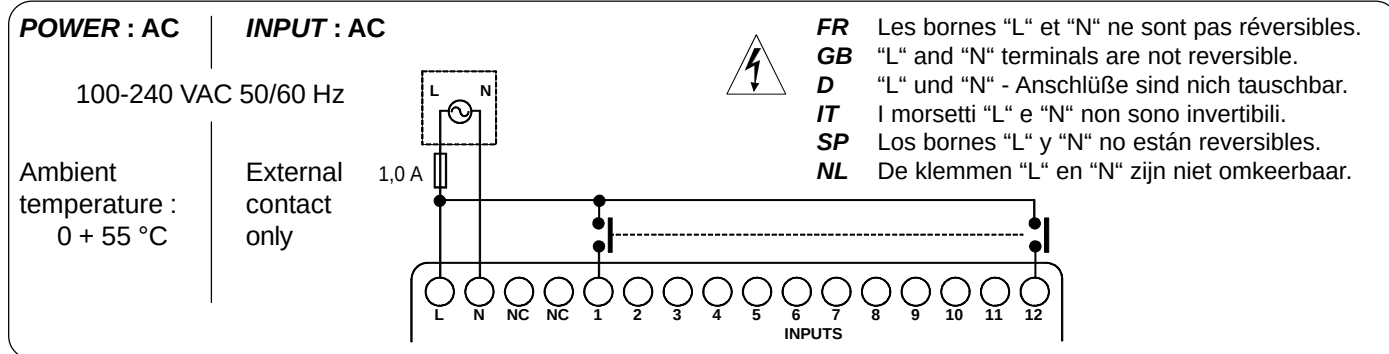
For a DC power supply, the positive conductor should be connected to the '+' terminal and the negative conductor to the '-' terminal.

The power supply terminals should not be connected to the other module terminals.

4.4 Wiring diagram, MAS 6-10

POWER : AC 100-240 VAC 50/60 Hz Ambient temperature : 0 + 55 °C	INPUT : AC External contact only	FR Les bornes "L" et "N" ne sont pas réversibles. GB "L" and "N" terminals are not reversible. D "L" und "N" - Anschlüsse sind nicht tauschbar. IT I morsetti "L" e "N" non sono invertibili. SP Los bornes "L" y "N" no están reversibles. NL De klemmen "L" en "N" zijn niet omkeerbaar. 
POWER : DC 24 VDC + 20 % - 15 % Ambient temperature : 0 + 55 °C	INPUT : DC External contact only	NPN 
POWER : DC 24 VDC + 20 % - 15 % Ambient temperature : 0 + 55 °C	INPUT : DC External contact only	PNP 
OUTPUT : RELAY Resistive load : 8 A 250 VAC 30 VDC Inductive load : 125 VAC : 245 VA (1/3 hp) 250 VAC : 367 VA (1/2 hp)  7 mm 26-12 AWG 0.13-3.31 mm²		
OUTPUT : TRANSISTOR Resistive load : 1A / 8-24 Vcc ; 0,1A / 5-8 Vcc Inductive load : 1A / 24 Vcc (24W) FR Le 0V est à relier à la borne "-" de l'alimentation du Millenium. GB Connect the 0V to "-" terminal of Millenium power supply. D Der Nulleiter ist mit der "-" Klemme der Millenium-Stromversorgung zu verbinden. IT Lo 0V deve essere collegato al morsetto "-" dell'alimentazione del Millenium. SP El 0V se ha de conectar al borne "-" de alimentación del Millenium. NL De 0V is verbonden aan de "-" klem van de voeding. 		

4.5 Wiring diagram, MAS 20



5. User safety and protection of equipment

- This manual contains all the diagrams and explanations which will guide the user in installing and using MILLENIUM products correctly. This manual should be read and understood prior to use or installation.
- If you have any doubts while installing MILLENIUM products or require any further information, consult your Crouzet distributor.
- This manual may be amended without prior notification.

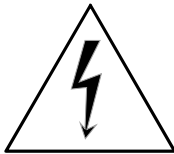
This manual is intended for use by competent personnel trained in installation of this equipment as defined in the following European directives :

Machinery (98/37/EEC)
Low voltage (73/23/EEC)
EMC (89/336/EEC).

Installation and electrical connections must be performed by a qualified technician.

This manual uses the symbols below to highlight information relating to the safety of personnel and the protection of equipment. Where these symbols appear, the associated comments should be read and understood.

The symbols are :



The identified danger will cause material damage.



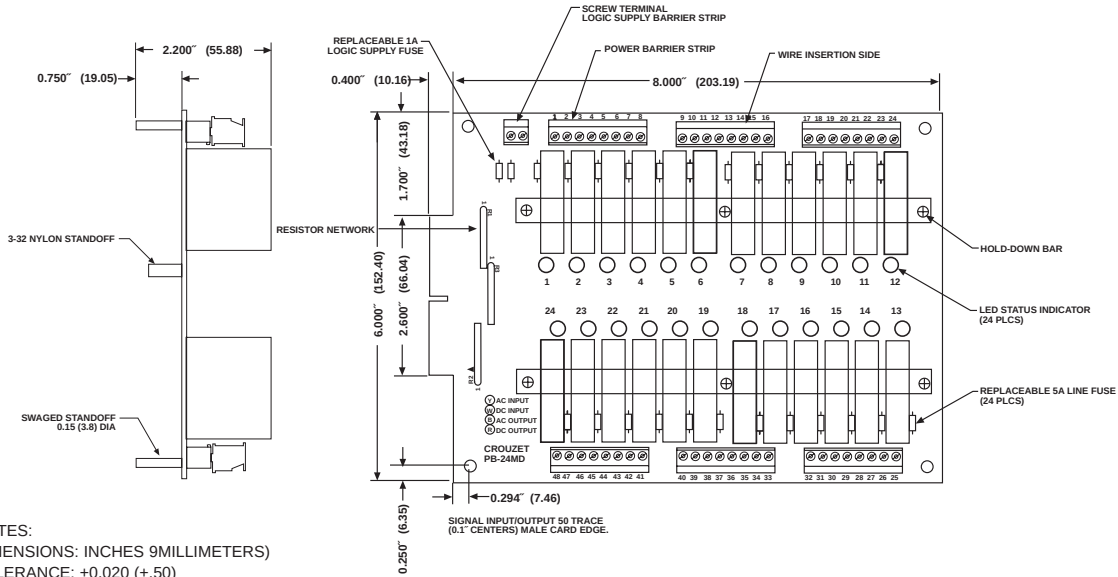
The identified danger is liable to cause material damage.

- In no circumstances can Crouzet Limited be held responsible for damage arising as a result of installing or using this equipment.
- All examples and diagrams in this manual are intended to aid comprehension. Their application is entirely the responsibility of the user. Crouzet Limited will not accept any responsibility for actual use of this product based on these examples.
- It is up to the user to assess the suitability of this product for his applications.
- In the event of product malfunction, the integral safety features should prevent dangerous situations.
- Never modify or repair MILLENIUM products.
- Check that MILLENIUM products comply with existing national and local standards.

DIGITAL I/O MODULE MOUNTING BOARDS

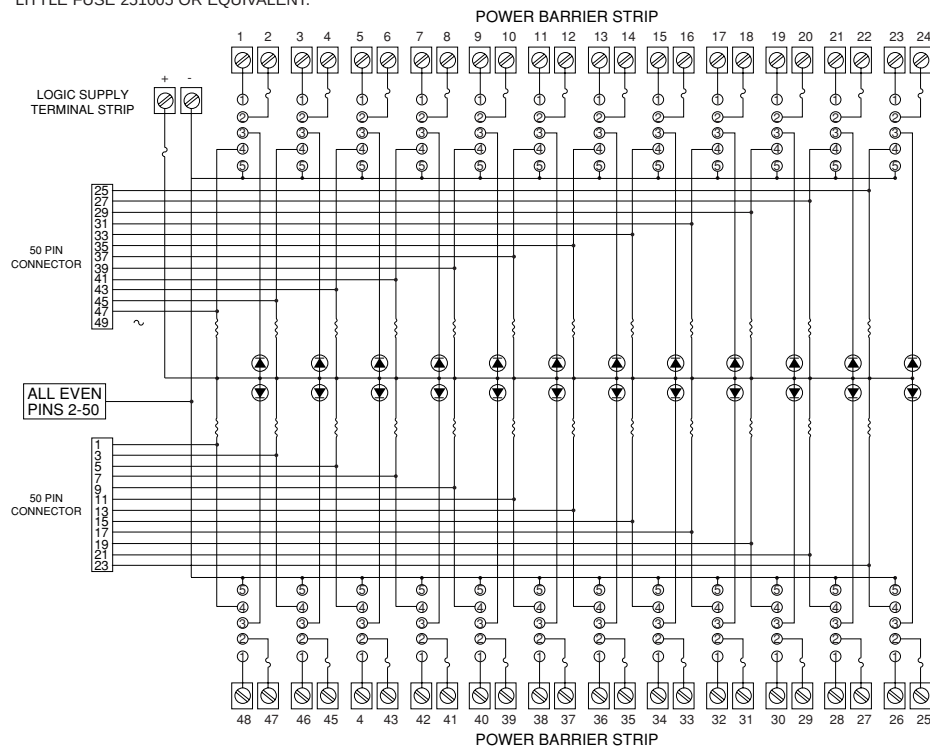
FOR "M" SERIES MINIATURE MODULES

PB24MD



NOTES:
DIMENSIONS: INCHES 9MILLIMETERS)
TOLERANCE: +0.020 (+.50)

- NOTES: 1) MATING CONNECTOR IS BERG66317-150 OR EQUIVALENT. SPECIFY SUFFIX 'C' FOR OPTIONAL 65823-093 OR EQUIVALENT MALE PIN CONNECTOR FOR PARALLEL-TO-THE-BOARD CABLE CONNECTION. SPECIFY SUFFIX 'V' FOR OPTIONAL CIRCUIT ASSEMBLY CA-50H-2B-SR OR EQUIVALENT MALE PIN CONNECTOR FOR PERPENDICULAR-TO-THE-BOARD CABLE CONNECTION.
2) 4-40 TERMINAL STRIPS ACCEPT WIRE SIZES FROM 26 TO 14 AWG.
3) OPTIONAL JUMPERS ARE AVAILABLE TO INTERCONNECT BARRIER STRIP ORDER "JM8"
4) PHOENIX MKD51.5 5.08mm SERIES (OR EQUIVALENT) SCREW TERMINAL BLOCKS STANDARD. SPECIFY SUFFIX "A" FOR BOARD-MOUNTED PHOENIX MSTBVA 1.5/16-G-5.08 (OR EQUIVALENT) MALE CONNECTOR. SPECIFY SUFFIX "B" FOR BOARD-MOUNTED PHOENIX MSTBVA 1.5/16-G-5.08 (OR EQUIVALENT) MALE CONNECTOR AND MATING PHOENIX MSTBVA 1.5/16-ST-5.08 (OR EQUIVALENT) FEMALE. SCREW-TERMINAL PLUG-IN CONNECTOR.
5) LITTLE FUSE 251001 OR EQUIVALENT.
6) LITTLE FUSE 251005 OR EQUIVALENT.



Products and specifications subject to change without notice.
Consult factory for application assistance.



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Keyword or Part #

search

Water Safety &
Flow Control

Backflow
Prevention

Water Quality
Products

Drainage
Products

Brass &
Tubular

Control
Valves

Potable PEX
Plumbing

Quick-Connect
Solutions

Marine
Products

OEM
Division

Search Watts

Watts product catalog at your fingertips

[HOME](#) > [Search](#) > **N55B**



N55B

Water Pressure Reducing Valves

Size(s) : 1/2 to 1 in. (15 to 25mm)

Description:

Series N55B Water Pressure Reducing Valves are used in commercial and residential applications to reduce incoming water pressure for protection of plumbing system components and to reduce water consumption. It consists of a bronze body construction integral stainless steel strainer, thermoplastic seat, bronze sealed spring cage for waterworks pit installations and thermal expansion bypass. The N55B is available with either threaded, solder, PEX or CPVC end connections. Maximum Working Pressure: 400psi (27.6 bar), Adjustable Reduced Pressure Range: 25 to 75psi (172 to 517 kPa), Standard Pressure Setting: 50psi (345 kPa).

Model / UPC Code

UPC	Part #	Description
098268204728	0008235	3/4 N55B G M1

For Residential and Commercial Applications

Job Name _____
 Job Location _____
 Engineer _____
 Approval _____

Contractor _____
 Approval _____
 Contractor's P.O. No. _____
 Representative _____

Series N55B-M1 Water Pressure Reducing Valves*

Sizes: 1/2" – 1" (15 – 25mm)

Series N55B-M1 Water Pressure Reducing Valves are designed to reduce incoming water pressure to a sensible level to protect plumbing system components and reduce water consumption. This series is suitable for water supply pressures up to 400psi (27.6 bar) and may be adjusted from 25 to 75psi (172 – 517kPa). The standard setting is 50psi (345kPa). All parts are quickly and easily serviceable without removing the valve from the line. The standard bypass feature permits the flow of water back through the valve into the main when pressures, due to thermal expansion on the outlet side of the valve, exceed the pressure in the main.

Features

- Double union inlet & outlet connections (option DU)
- Integral stainless steel strainer
- Thermoplastic seat
- Bronze body construction
- Serviceable in line
- Bypass feature controls thermal expansion pressure**
- Sealed spring cage on all models for waterworks pit installations

Models

N55B-M1	NPT threaded female inlet x NPT female outlet
N55BU-M1	NPT threaded union inlet x NPT female outlet
N55BU-S-M1	Solder union inlet x NPT female outlet
N55BDU-M1	Double Union – NPT threaded union female inlet and outlet
N55BDU-S-M1	Double Union – Solder union inlet and outlet
N55BDU-PEX-M1	Double Union – PEX union inlet and outlet
N55BDU-CPVC-M1	Double Union – CPVC union inlet and outlet

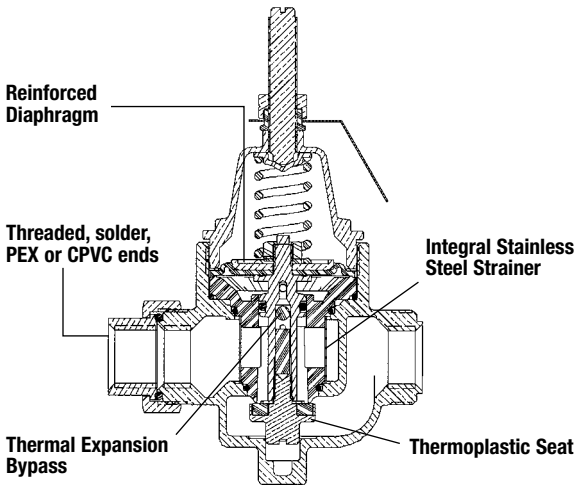
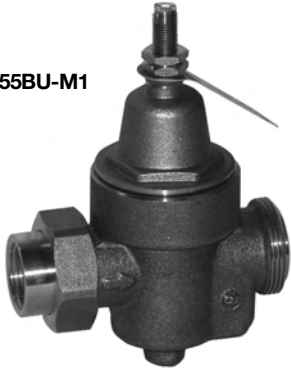
Specifications

Standard Specifications: A Water Pressure Reducing Valve with integral strainer shall be installed in the water service pipe near its entrance to the building where supply main pressure exceeds 60psi (413 kPa) to reduce it to 50psi (345 kPa) or lower. The valve shall feature a bronze body suitable for water supply pressures up to 400psi (27.6 bar). Provision shall be made to permit the bypass flow of water around the valve back into the main when pressures, due to thermal expansion on the outlet side of the valve, exceed the pressure in the main. Water Pressure Reducing Valve with built-in bypass check valves will be acceptable. Approved valve shall be listed to ASSE 1003 and IAPMO and certified to CSA B356. Valve shall be a Watts Regulator Company Series N55B-M1.

* A water saving test program concluded that reducing the supply pressure from 80 – 50psi (551 – 346kPa) resulted in a water savings of 30%.

** Bypass will not work if inlet pressure is above 150psi (10.34 bar).

N55BU-M1



Lead Free Specifications: A Water Pressure Reducing Valve with integral strainer shall be installed in the water service pipe near its entrance to the building where supply main pressure exceeds 60psi (413 kPa) to reduce it to 50psi (345 kPa) or lower. The valve shall feature a bronze body where suitable for water supply pressures up to 400psi (27.6 bar). The combined metal components of the valve contacted by potable water shall contain less than one half of one percent (0.5%) lead by weight. Provision shall be made to permit the bypass flow of water around the valve back into the main when pressures, due to thermal expansion on the outlet side of the valve, exceed the pressure in the main. Water Pressure Reducing Valve with built-in bypass check valves will be acceptable. Approved valve shall be listed to ASSE 1003 and IAPMO and certified to NSF 61-8 and CSA B356. Valve shall be a Watts Regulator Company Series LF N55B-M1.



Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.

Materials

Body:	Bronze
Seat:	Thermoplastic
Cage:	Bronze
Integral Strainer:	Stainless steel
Diaphragm:	Reinforced EPDM
Valve Disc:	Elastomer

Pressure — Temperature

Temperature Range: 33°F – 180°F (5°C – 82°C)

Maximum Working Pressure: 400psi (27.6 bar)

Adjustable Reduced Pressure Range: 25 – 75psi (172 – 517kPa)

Standard Reduced Pressure Setting: 50psi (345kPa)

Standards



Meets requirements of ASSE Standard 1003; (ANSI A112.26.2) and CSA Standard B356. Certified by NSF to ANSI/NSF Standard 61-8 (LF N55B-M1 Models only). Listed by IAPMO and City of Los Angeles.

Options

Add Suffix

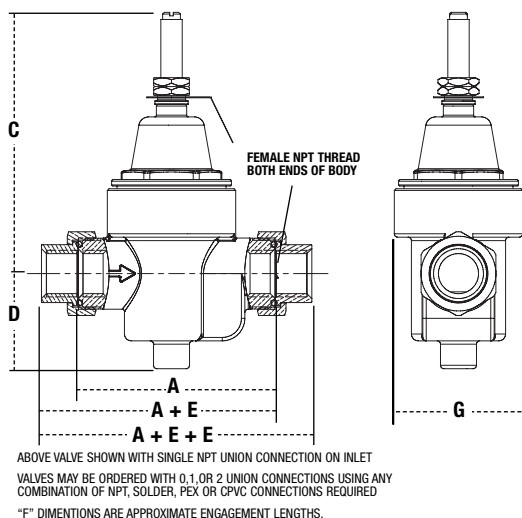
G	Gauge tapping
GG	Gauge tapping and 160psi (11 bar) gauge
LP	Low Pressure Range 10-35psi (69-241kPa)

Add Prefix

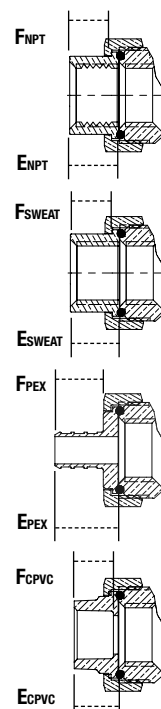
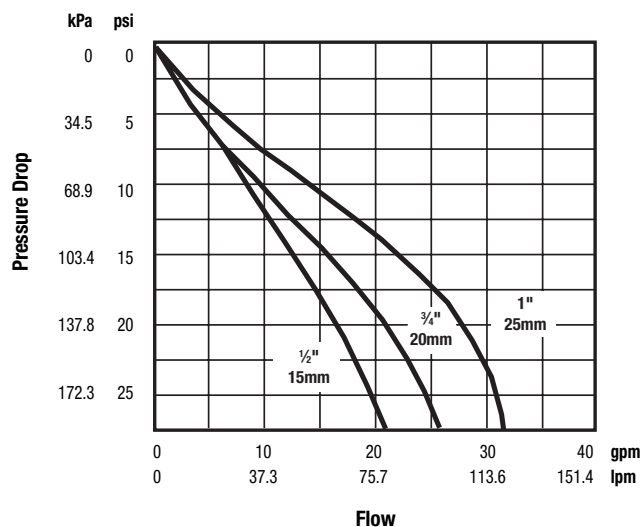
LF	Lead Free [†] construction
----	-------------------------------------

[†]The combined metal components of this product contacted by potable water contain less than one half of one percent (0.5%) of lead by weight.

Dimensions – Weights



Capacity



SIZE (DN)		DIMENSIONS										WEIGHT			
in.	mm	A	C	D	ENPT	ESWEAT	EPEX	ECPVC	FNPT	FSWEAT	FPEX	FCPVC	G	lbs	kg
1/2	15	37/16 88	49/16 116	11 1/16 43	5/8 16	5/8 15	13/16 21	9/16 15	1/2 13	1/2 13	5/8 16	1/2 13	2 1/4 57	1.5	.68
3/4	20	37/16 88	49/16 116	11 1/16 43	5/8 16	7/8 21	15/16 24	13/16 21	9/16 14	3/4 19	5/8 16	3/4 18	2 1/4 57	1.5	.68
1	25	4 1/8 105	49/16 116	11 1/16 43	3/4 20	1 26	1 1/8 29	1 1/16 26	1 1/16 17	15/16 23	13/16 21	15/16 23	2 1/4 57	1.75	.79



Water Safety & Flow Control Products



USA: 815 Chestnut St., No. Andover, MA 01845-6098; www.watts.com

Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattscanada.ca

ES-N55B 0608

© Watts Regulator Company, 2006

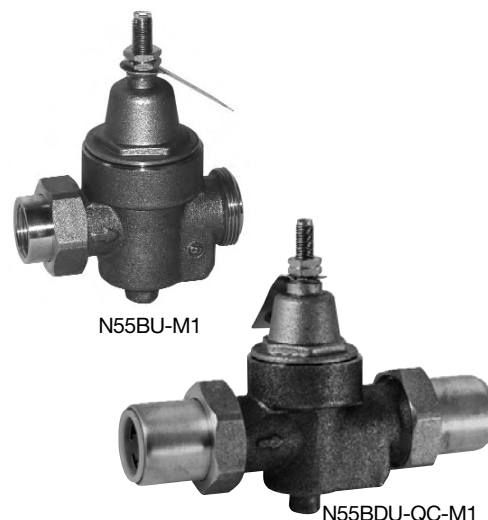
Watts Series N55B-M1

1/2" - 1" (15-25mm)

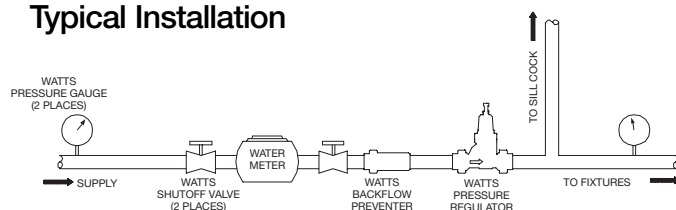
Installation Instructions

1. The valve should be installed by a licensed contractor in accordance with local codes and ordinances. This valve should be installed where it is accessible with sufficient clearance for cleaning, service, or adjustment.
2. Before installing the valve, be sure that the pipe ends are reamed and threads are cut to size. For valves with Quick-Connect tailpieces refer to "Quick-Connect Installation" instructions below.
3. Flush the lines to remove all loose scale, dirt and other foreign matter that can damage or clog the valve.
4. Install the regulator with the arrow on the body pointing in the direction of the flow.
5. Regulator may be installed vertically or horizontally (upright or inverted).
6. Start Up — Open cold water supply then hot water supply. Inspect for leaks.

Note: The valve should be inspected annually to assure maximum life and performance.

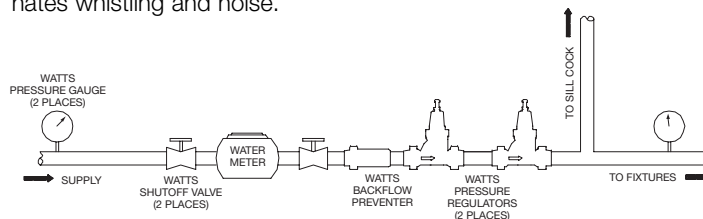


Typical Installation



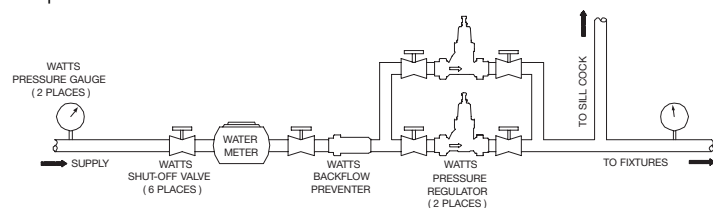
Series Installation

Series installations are recommended where very high supply pressure must be reduced to a very low downstream pressure. Reducing the pressure in stages eliminates whistling and noise.



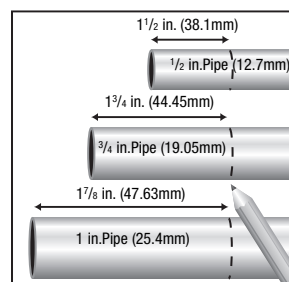
Parallel Installation

Parallel installations are recommended where high flow or low flow demand is intermittent/occasional. They are also used for installations where service cannot be interrupted.

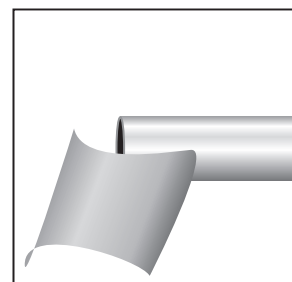


Quick-Connect Installation

To Connect

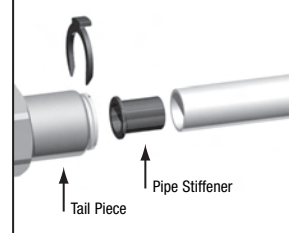


1. Mark pipe as shown. This is pipe insertion depth.

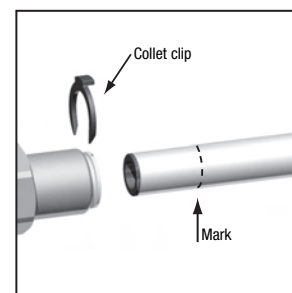


2. Clean pipe end.

PEX tubing only

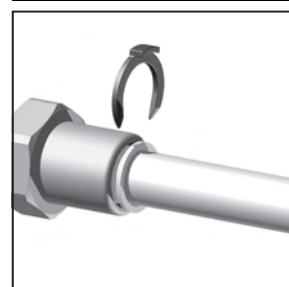


3. If using PEX tubing, insert pipe stiffener (provided) into end of pipe.

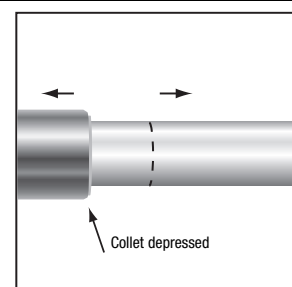


4. Push tubing into tailpiece up to mark.
5. Insert collet clip.

To Disconnect



1. Remove collet clip.



2. Depress collet.
3. Pull tubing from tailpiece.

WATTS®

Maintenance Instructions

- To clean strainer or replace seat/stem module shut off supply, loosen Locknut and Lock Seal and back off Adjusting Screw.
- Remove Spring Cage, Spring, Washer and Slip Ring. Grasp Stem Nut with fingers or pliers and lift module from body.
- Replace module and reassemble valve.
- Readjust pressure setting.

Adjustment

Regulator is factory preset to 50psi (344 kPa). To adjust pressure setting, loosen the lock nut and turn the adjusting bolt clockwise to increase pressure, counter clockwise to decrease pressure.

Note: Use a pressure gauge downstream to adjust and verify the pressure setting.

By-Pass Feature*

This regulator has a built-in thermal expansion by-pass feature. This feature prevents downstream pressure from rising to more than 10psi above the supply pressure.

* By-Pass will not work if inlet pressure is above 150psi (10.3 bar).

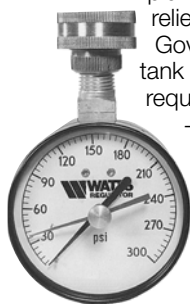
Troubleshooting

High System Pressure

If the downstream system pressure is higher than the set pressure under no flow conditions, the cause could be thermal expansion, pressure creep or dirt/debris on the seat.

Thermal expansion occurs whenever water is heated in a closed system. The system is closed when supply pressure exceeds 150psi, or a check valve or backflow preventer is installed in the supply piping.

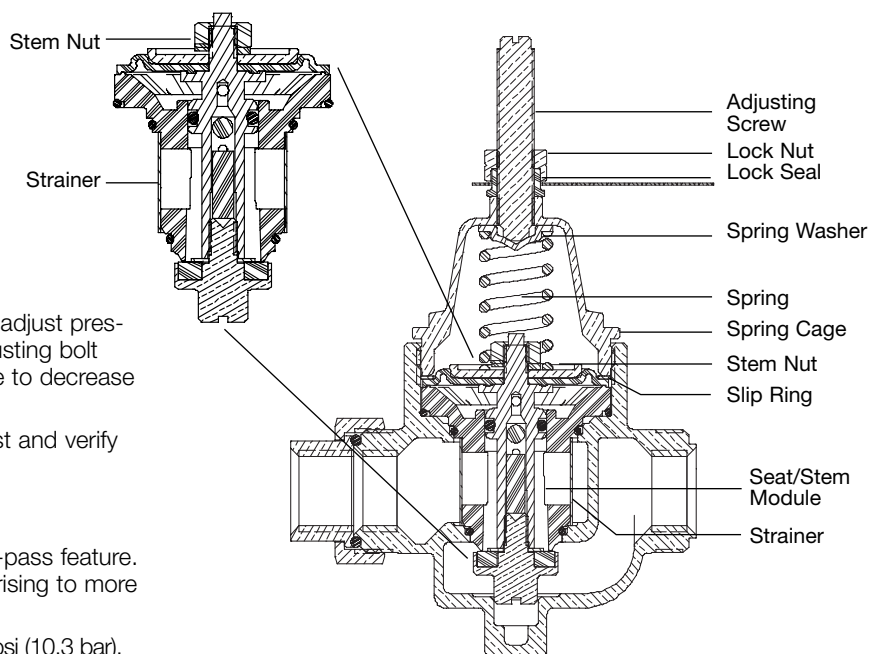
You must make provisions for pressure relief protection of your plumbing system and components. The use of a relief valve such as the Watts 530C, BRV, Governor 80, or 3L or potable water expansion tank such as the Watts DET, PLT or DETA may be required.



Watts 276H300

To determine if this is the result of thermal expansion, try briefly opening the cold water tap. If the increased pressure is caused by thermal expansion, the pressure will immediately be relieved and the system will return to the set pressure. Watts offers a pressure test gauge, model 276H300 to assist you in determining if you have high water pressure. The 276H300 when attached to a hose bibb registers the highest pressure reading over the period of time it is left on the system.

SEAT/STEM MODULE



Repair Kit

KIT NO.	SIZE		ORDERING CODE	KIT INCLUDES
	in.	mm		
½ - 1 N55B-RK	½, ¾, 1	15, 20, 25	0007723	Seat/Stem Module

WARNING!

For valves with CPVC or PEX end connections do not exceed the tubing manufacturers pressure and temperature ratings. Refer to the tubing manufacturers product specifications for that information.

CALIFORNIA PROPOSITION 65 WARNING

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. (California law requires this warning to be given to customers in the State of California.)

For more information: www.watts.com/prop65

Limited Warranty: Watts Regulator Company warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge. This shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the product. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** Any implied warranties that are imposed by law are limited in duration to one year.

Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights.

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Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattscanada.ca



Direct Lift, Pilot Operated 2-way and 3-way Control Valves



Goyen manufactures and distributes valves that are designed for specific applications relating to the control of gas, fuel, air or water. There are two principal types of operation for solenoid valves – direct lift and pilot operated.

Direct Lift Valves

In these models, movement of the plunger directly opens or closes the valve as the sealing disc is attached to the plunger. The valve will operate from zero pressure differential to its maximum rated pressure.

Pilot Operated Valves

These models are equipped with a diaphragm or piston which provides the seal for the main valve orifice. These valves are used to handle much greater flow or pressure requirements than direct acting valves.

Two designs of pilot operated valves are available, either a floating diaphragm which requires a small pressure drop across the main valve orifice to remain in the open position, or a coupled diaphragm which is mechanically held open via a direct linkage to the solenoid plunger. The coupled design will operate with zero pressure drop across the main valve orifice.

Both Direct Lift and Pilot Operated Valves are available in normally open or normally closed configuration.

2-way Valves

These valves have one inlet port and one outlet port and are used as an on/off valve to control the flow of liquids or gases.

3-way Valves

These valves enable the application and release of pressure from closed end systems, such as single acting cylinders.

General Industrial Control Valves - Direct Lift

Q3M Series - 2 way - Normally Closed

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
1Q3M	3	1/8	0-2550	0-370	1.6	0.062	0.1	0.09
2Q3M	3	1/8	0-1000	0-150	2.4	0.093	0.2	0.17
3Q3M	3	1/8	0-700	0-100	2.8	0.109	0.3	0.26
4Q3M	3	1/8	0-500	0-75	3.2	0.125	0.3	0.26

B6M and BL Series - 2 way - Normally Closed

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
1B6M	6	1/4	0-2100	0-300	1.6	0.062	0.1	0.09
2B6M	6	1/4	0-1200	0-175	2.4	0.093	0.2	0.17
4B6M	6	1/4	0-1000	0-150	3.2	0.125	0.3	0.26
5B6M	6	1/4	0-400	0-60	4.8	0.187	0.5	0.43
6B6M	6	1/4	0-200	0-30	6.0	0.235	0.7	0.6
10BL2	10	3/8	0-70	0-10	9.5	0.375	2.1	1.81
12BL2	12	1/2	0-40	0-6	12.7	0.500	3.5	3.01

B6M and Q3M Series - 2 way - Normally Open

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
1Q3M	3	1/8	0-860	0-125	1.6	0.062	0.1	0.09
2Q3M	3	1/8	0-400	0-60	2.4	0.093	0.2	0.17
4Q3M	3	1/8	0-200	0-30	3.2	0.125	0.3	0.26
1B6M	6	1/4	0-2100	0-300	1.6	0.062	0.1	0.09
2B6M	6	1/4	0-1200	0-175	2.4	0.093	0.2	0.17
4B6M	6	1/4	0-1000	0-150	3.2	0.125	0.3	0.26

Q3M and B6M Series - 3 way - Normally Closed and Normally Open

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
1Q3M3	3	1/8	0-860	0-125	1.6	0.062	0.1	0.09
2Q3M3	3	1/8	0-400	0-60	2.4	0.093	0.2	0.17
4Q3M3	3	1/8	0-200	0-30	3.2	0.125	0.3	0.26
1B6M3	6	1/4	0-860	0-125	1.6	0.062	0.1	0.09
2B6M3	6	1/4	0-400	0-60	2.4	0.093	0.2	0.17
4B6M3	6	1/4	0-200	0-30	3.2	0.125	0.3	0.26

Port threads standard in 'RC' and 'NPT'. Others available on request.



12BW2 - NC



12BW2 - NO



40BW2

BW-BWJ Series - Operation and Installation

Installation

Check the valves identification label for correct part number, working pressure and power supply requirements. Only suitably qualified personnel should install and maintain this product.

Mounting

These valves are designed to be mounted in any position or orientation. It is preferable to mount the valve horizontally with the solenoid coil vertically uppermost. This will minimise the accumulation of sediment in the moving parts of the valve.

Goyen strongly recommend the use of a strainer or filter immediately upstream of the valve to ensure optimum life and performance.

Piping Connections

Ensure that the valve is installed with the arrow pointing in the direction of flow. Thread sealant or tape should be applied sparingly to the male threads only. Excessive use of sealant is wasteful and could lead to blockage or valve failure.

When tightening pipework into the valve do not use the valve or solenoid as a lever. Minimise strain on the valve body by ensuring that pipework is well aligned and supported.

Safety

Before commencing any service to a valve always ensure that electrical power is isolated from the valve and the valve is relieved from fluid pressure.

Pilot Operated Control Valves

BW Series - Brass Body - Normally Closed

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
6BW2	6	1/4	20-1000	3-150	6.4	0.25	1.1	0.95
10BW2	10	3/8	20-1000	3-150	9.5	0.38	2.1	1.81
12BW2	12	1/2	20-1000	3-150	12.7	0.50	3.5	3.01
20BW2	20	3/4	20-1000	3-150	19.0	0.75	7.7	6.62
25BW3	25	1	20-1000	3-150	25.4	1.00	13.2	11.35
40BW2	40	1 1/2	20-1000	3-150	38.1	1.50	24.0	20.64

QW Series - Brass Body - Normally Closed

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
6QW2	6	1/4	20-1000	3-150	6.4	0.25	1.1	0.95
10QW2	10	3/8	20-1000	3-150	9.5	0.38	2.1	1.81
12QW2	12	1/2	20-1000	3-150	12.7	0.50	3.5	3.01

BWJ Series - Brass Body - Normally Closed

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
6BWJ2	6	1/4	0-1000	0-150	6.4	0.25	1.1	0.95
10BWJ2	10	3/8	0-1000	0-150	9.5	0.38	2.1	1.81
12BWJ2	12	1/2	0-1000	0-150	12.7	0.50	3.5	3.01
20BWJ2	20	3/4	0-700	0-100	19.0	0.75	7.7	6.62
25BWJ2	25	1	0-400	0-60	25.4	1.00	13.2	11.35

QWJ Series - Brass Body - Normally Closed

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
6QWJ2	6	1/4	0-1000	0-150	6.4	0.25	1.1	0.95
10QWJ2	10	3/8	0-1000	0-150	9.5	0.38	2.1	1.81
12QWJ2	12	1/2	0-1000	0-150	12.7	0.50	3.5	3.01

BW Series - Brass Body - Normally Open

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
12BW2-NO	12	1/2	20-1000	3-150	12.7	0.50	3.5	3.01
20BW2-NO	20	3/4	20-1000	3-150	19.0	0.75	7.7	6.62
25BW3-NO	25	1	20-1000	3-150	25.4	1.00	13.2	11.35
40BW2-NO	40	1 1/2	20-1000	3-150	38.1	1.50	24.0	20.64

BXX Series - Brass Body - Normally Open - Air to Close

Model	Pipe Size		Pressure		Orifice Size		Cv	Kv
	mm	inch	kPa	psi	mm	inch		
6BXX2	6	1/4	70-1000	10-150	6.4	0.25	1.1	0.95
10BXX2	10	3/8	70-1000	10-150	9.5	0.38	2.1	1.81
12BXX2	12	1/2	70-1000	10-150	12.7	0.50	3.5	3.01
20BXX2	20	3/4	70-1000	10-150	19.0	0.75	7.7	6.62
25BXX2	25	1	70-1000	10-150	25.4	1.00	13.2	11.35

Port threads standard in 'RC' and 'NPT'. Others available on request.

Wiring

Wiring installation must comply with your local electrical codes, within Australia this code is AS3000-1991.

Valves designed for use in hazardous locations are covered by further standards such as AS2381.1-1991 and AS2381.2-1993. Only approved conduits or cable seals should be used in these installations. Never remove covers or seals from hazardous rated equipment before isolating the power supply.

Note: Most solenoid valves are designed for either AC or DC power supply and are so constructed that conversion from one type to the other may require changing the whole top section of the valve.

The normally open range of BW valves do not differ in AC versus DC construction.

Troubleshooting

Valve fails to open when power is applied:

- No power to the coil due to faulty wiring or a blown fuse.
- Open circuit coil or internally shorted to earth.
- Supply voltage may be less than 85 of nominal rating.
- Fluid pressure may exceed maximum rating.

Valve leaks or fails to close:

- Debris caught in moving parts of valve or bleed hole in diaphragm is blocked.

Valve noisy (humming) with AC operation:

- Debris caught between plunger and iron top.

Note: A metallic click should be heard when power is applied. This should indicate correct solenoid function.

Maintenance

Ensure that fluids flowing through the valve are as free from dirt and foreign matter as conditions allow.

Operate the valve on a regular basis and at least monthly.

Periodic inspection and cleaning of the valve's internal components is highly recommended. Maintenance periods will be dictated by individual situations and the type of fluids handled.

Only genuine Goyen repair kits are recommended.

Spare Parts

(Kits consist of plunger, spring, seals and diaphragm)

BW Normally Closed Series

Valve Model	Diaphragm and Seal Material		
	NBR (Nitrile)	FMK (Viton)	EPDM
6BW2(AC)	KM1628	KM1721	KM1725
6BW2(DC)	KM1656	KM1660	KM1892
10BW2(AC)	KM1628	KM1721	KM1725
10BW2(DC)	KM1656	KM1660	KM1892
12BW2(AC)	KM1626	KM1722	KM1726
12BW2(DC)	KM1657	KM1661	KM1893
20BW2(AC)	KM1627	KM1723	KM1727
20BW2(DC)	KM1658	KM1662	KM1894
25BW3(AC)	KM3013	KM3010	KM3011
25BW3(DC)	KM3017	KM3014	KM3016
40BW2(AC)	KM1459	KM1460	KM1462
40BW2(DC)	KM2423	KM2424	KM2425

BW Normally Open Series

Valve Model	Diaphragm and Seal Material		
	NBR (Nitrile)	FMK (Viton)	EPDM
Seal Kits:			
12BW2-NO	KM1783	KM1784	KM1785
20BW2-NO	KM1928	KM1929	KM1930
25BW3-NO	KM1647	KM1648	KM1649
40BW2-NO	KM1786	KM1787	KM1788
Pilot Kits:			
All Models	KM1789	KM1790	KM1791

BWJ Normally Closed Series

Valve Model	Diaphragm and Seal Material		
	NBR (Nitrile)	FMK (Viton)	EPDM
6BWJ2(AC)	KM1584	KM1596	KM1600
6BWJ2(DC)	KM1664	KM1668	KM1918
10BWJ2(AC)	KM1584	KM1596	KM1600
10BWJ2(DC)	KM1664	KM1668	KM1918
12BWJ2(AC)	KM1585	KM1597	KM1601
12BWJ2(DC)	KM1665	KM1669	KM1919
20BWJ2(AC)	KM1586	KM1598	KM1602
20BWJ2(DC)	KM1666	KM1670	KM1920
25BWJ2(AC)	KM1587	KM1599	KM1603
25BWJ2(DC)	KM1667	KM1671	KM1921

BW - Normally Closed - Hazardous

Valve Model	Diaphragm and Seal Material		
	NBR (Nitrile)	FMK (Viton)	EPDM
12BW2-H(AC)	KM1827	KM1828	KM1829
12BW2-H(DC)	KM1830	KM1831	KM1832
20BW2-H(AC)	KM1833	KM1834	KM1835
20BW2-H(DC)	KM1836	KM1837	KM1838
25BW3-H(AC)	KM1839	KM1840	KM1841
40BW2-H(AC)	KM1845	KM1846	KM1847

Spare Parts (cont'd)

(Kits consist of plunger, spring, seals and diaphragm)

BXX Series

Valve Model	Diaphragm and Seal Material		
Seal Kits:	NBR (Nitrile)	FMK (Viton)	EPDM
6BXX2	KM1208A	KM1521	KM2392
10BXX2	KM1208A	KM1521	KM2392
12BXX2	KM1211A	KM1773	KM1991
20BXX2	KM1212A	KM 1523	KM 1992
25BXX2	KM2551	KM 1524	KM 1993

Direct Lift Valves - 3 way

Valve Model	Seal Material		
Seal Kits:	NBR (Nitrile)	FMK (Viton)	EPDM
Q3M3 NC	KM2450	KM2452	KM2454
Q3M3 NO	KM2551	KM2552	KM2553
B6M3 NC	KM1337	KM1416	KM1418
B6M3 NO	KM1336	KM1413	KM1415

Direct Lift Valves - 2 way - normally open

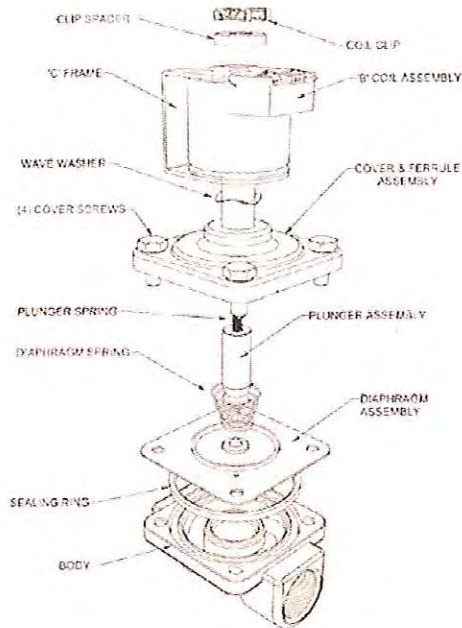
Valve Model	Seal Material		
Seal Kits:	NBR (Nitrile)	FMK (Viton)	EPDM
Q3M	KM2551	KM2552	KM2553
B6M	KM1336	KM1413	KM1415

Direct Lift Valves - 2 Way - Normally Closed

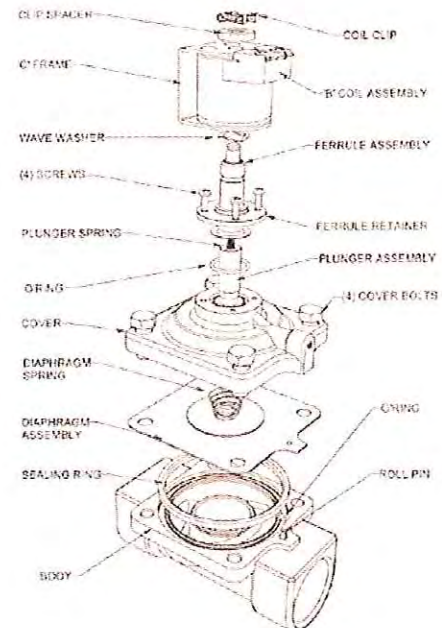
Valve Model	Seal Material		
	NBR (Nitrile)	FMK (Viton)	EPDM
Q3M (AC/DC)	KM1347	KM1348	KM1469
B6M (AC)	KM1349	KM1350	KM1408
B6M (DC)	KM2447	KM2448	KM2449
10BL2 (AC)	KM1423	KM2403	KM2404
10BL2 (DC)	KM2402	KM2411	KM2412
12BL2 (AC)	KM1427	KM2405	KM2406
12BL2 (DC)	KM3015	KM2413	KM2414

Construction

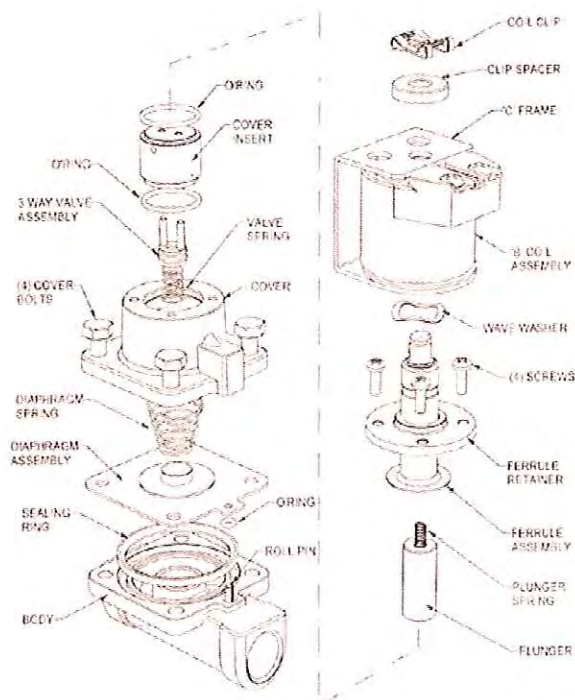
6, 10, 12, 20BW2 Valves Normally Closed Typical Construction



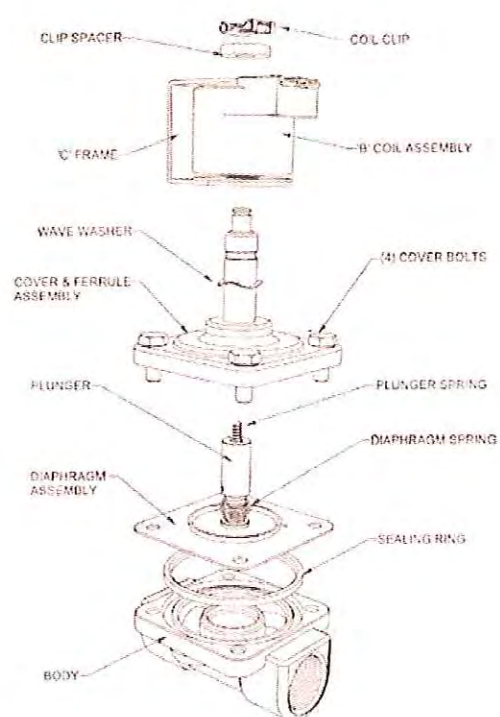
25BW3 and 40BW2 Valves Normally Closed Typical Construction



BW2 Valves Normally Open - Typical Construction



BWJ2 Series Normally Closed - Typical Construction



Solenoid Coil Options



Solenoid Coils

All coils are continuously rated within +10 to -15 of nominal voltage and encapsulated in a moisture and abrasion resistant self extinguishing nylon.

Coil insulation is "Class B" rated at 130°C.

B Series Coils

BD: Basic Coil and Enclosure

Coil and junction box enclosure provides 8 UNC, coil and earth terminals with M20 x 1.5 or 1/2" NPSC conduit entry.

Protection Class: IP31; NEMA 1

BC: Open frame coil with exposed 8 UNC screw terminals, for connection within a cabinet or other enclosure.

BR: Plug in coil and DIN40050 socket with PG9 cable gland, for internal or external installation. Weather, dust and hose proof. Protection Class: IP65; NEMA4

AC - B Coils

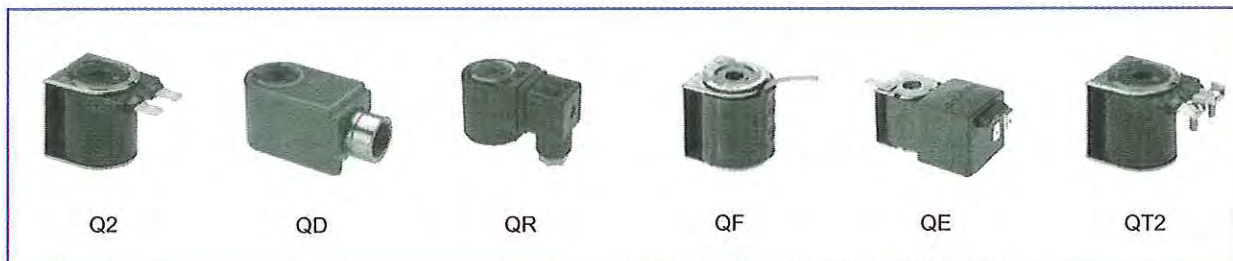
Volts	Hz	Inrush mA	Holding mA
12	50	4040	1670
24	50	2000	830
24	60	1720	660
32	50	1260	520
48	50	980	380
48	60	1070	410
110	50	405	157
110	60	496	195
120	60	370	142
240	50	172	70
415	50	80	30

BH: Explosion proof enclosure for hazardous locations. Protection Class: ExdIIB Class I Zone 1, Class II; IP65; DIP.

DC - B Coils

Volts	Hz	Holding mA
12	DC	1200
24	DC	596
32	DC	322
48	DC	302
74	DC	148
110	DC	113
240	DC	48

Coils not available in 32 Volts 60 Hz AC



Q Series Coils

Q2: Basic Coil

6mm [1/4"] spade terminals for push on connections within a cabinet or other enclosure.

QD: Coil and junction box enclosure provides 6 UNC coil and 8 UNC earth terminals, with an M20 x 1.E or Vs" NPSC conduit entry. Protection Class: IP31; NEMA 1

QR: Plug in coil and DIN40050 socket with PG9 cable gland, for internal or external installation. Weather, dust and hose proof. Protection Class: IP65, NEMA4.

QF: 450mm [18"] integral flying leads for direct connection to terminal strip, controller or junction box.

QE: Electronic module incorporating a pulse and hold circuit. Coil features low power consumption, low heat rise and zero hum. Available in 240VAC, 24VDC and 12VDC. Standard 6mm spade connector.

AC - Q Coils

Volts	Hz	Inrush mA	Holding mA
12	50	1238	788
24	50	800	520
24	60	822	510
32	50	590	370
32	60	490	285
110	50	192	123
110	60	160	94
120	60	180	110
240	50	86	55
415	50	36	22

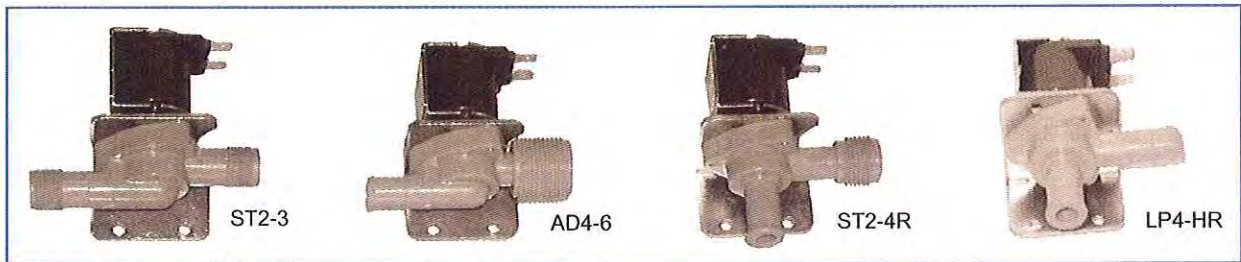
QT2: 6 UNC screw terminals for direct wiring within a cabinet or other enclosure.

DC - Q Coils

Volts	Hz	Holding mA
12	DC	719
24	DC	364
32	DC	262
48	DC	188
74	DC	116
110	DC	81
240	DC	39

Coils not available in 48 Volts 50 Hz AC and 48 Volts 60 Hz AC

Moulded Plastic Valves



Description & Typical Applications

Goyen manufactures three basic series of moulded plastic solenoid valves - ST2, LP4 and AD4.

The ST2 series are normally closed, pilot operated diaphragm valves, with typical applications on dish and glass washing machines, agricultural spraying equipment and vending machines.

The LP4 series are normally closed, direct lift solenoid valves with typical applications in vending machines.

The AD4 series are also a normally closed, direct lift solenoid valve, but a sealed diaphragm has been included to isolate the upper sections of the valve from the media being controlled. Typical applications are dispensing and vending equipment.

Construction

The ST2, the LP4 and the AD4 are available in either a 'straight through', or a 'right angle' configuration. The inlet connections can be either:

- 1/2" hose [-H]
- RP 3/8 [-3]
- RP 1/2 [-4]
- RP 3/4 [-6]

The outlet connections can be either:

- 1/2" hose
- RP 3/8

The ST2 is available in Nylon 6/6. The LP4 and AD4 are available in Nylon 6/6 [Blue], Polysulphone [Beige] and ABS [Black]. Diaphragm and/or seal materials may be Nitrile [BunaN], Viton or EPDM depending on the valve - see table.

Electrical

Coil types Q2, QT2 and QF are available [see page 7 for details], in AC and DC voltages. The duty cycle of the ST2 is 50% with maximum 'on' time of 30 minutes at 25°C ambient. The AD4 and LP4 have 100% duty cycle.

Spare parts

Kits contain plunger, spring seals and diaphragm if required. Kit numbers are listed below.

Valve Performance Data

Base Series	Orifice		Working Pressure		Diaphragm and/or Seal Material	Cv
	mm	inch	kPa	psi		
ST2	9.5	3/8	20-1000	3-150	Nitrile/Viton	1.9
LP4	9.5	3/8	0-21	0-3	EPDM	1.9
AD4	9.5	3/8	0-7	0-1	EPDM	1.9

Max. Fluid Temperature = 82°C

Max. ambient 25°C for this fluid temperature

Repair Kit

Base Series	Diaphragm and/or Seal Material	Repair Kit	
		AC	DC
ST2	Nitrile	KM1673	KM1673
	Viton	KM1682	KM1682
LP4	EPDM	KM2139	KM2545
AD4	EPDM	KM2134	KM2135

Gas Control Valves



10QLS



20BAL

Gas Control Valves

Low pressure

Goyen manufacture a range of normally closed, direct lift valves for use as shut-off valves for appliances and combustion burner systems.

Application

Principally used as safety shut-off valves for fuel gases such as town gas, L.P.G. and natural gas. Also used in industrial gas applications such as nitrogen, argon, carbon dioxide and acetylene. Typical product applications include:

Domestic: Gas cooking appliances, gas heaters, water heaters.

Industrial: Furnaces, boilers, water heaters, laboratory applications and welding equipment.

Commercial: Commercial gas appliances. Also used in marine, motor vehicle, campervan and mobile home gas installations.

High pressure

This range of pilot operated diaphragm valves are built specifically to handle compressed air or gases up to pressures of 1000 kPa (150 psi).

Application

Used as isolating valves in compressed air lines or in gas lines where the pressure exceeds the capability of the direct lift valves.

Construction

Bodies and covers are pressure diecast aluminium. Ferrule tubes, plungers, and springs are of 300 & 400 series stainless steel. Seals and diaphragms are Nitrile rubber, suitable for temperature ranges of -40°C (-40°F) to +60°C (+140°F). Coils are either Q or B series depending on the model. QLS2 valves are only available with the QE series coil.

Low Pressure Valves

Model	Pipe Size		Pressure		Orifice Size		Flow Factor		Approvals
	mm	inch	kPa	psi	mm	inch	Cv	Kv	
6QLS	6	1/4	0-7	0-1	6.4	0.250	1.1	0.95	1, 3
10QLS	10	3/8	0-7	0-1	9.5	0.375	2.1	1.81	1, 3
6QLS2	6	1/4	0-7	0-1	6.4	0.250	1.1	0.95	1, 3
10QLS2	10	3/8	0-7	0-1	9.5	0.375	2.1	1.81	1, 3
6QG	6	1/4	0-20	0-3	6.4	0.250	1.1	0.95	UL
10QG	10	3/8	0-20	0-3	9.5	0.375	2.1	1.81	UL
12BAL	12	1/2	0-7	0-1	12.7	0.500	3.5	3.01	
20BAL	20	3/4	0-10	0-1.5	19	0.750	7.7	6.62	3, UL

Approvals:

1 = Australian Gas Association AG214 Class 1

3 = Australian Gas Association AG214 Class 3

UL = UL429 Safety Shut-off valve

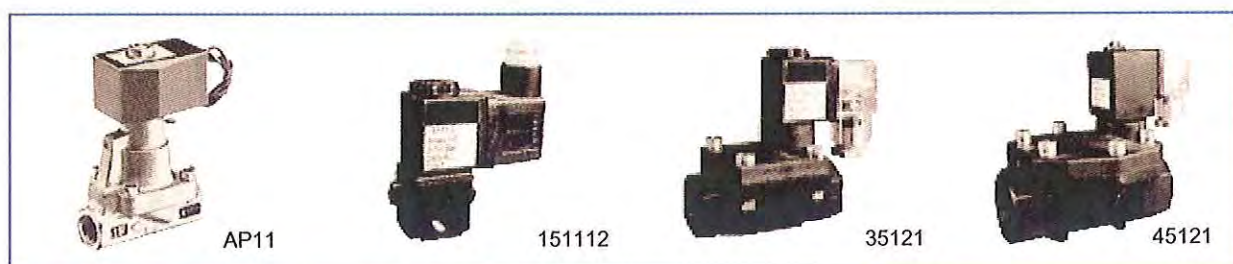
High Pressure Valves

Model	Pipe Size		Pressure		Orifice Size		Flow Factor	
	mm	inch	kPa	psi	mm	inch	Cv	Kv
12QA2	12	1/2	20-1000	3-150	12.7	0.500	3.5	3.01
12BA2	12	1/2	20-1000	3-150	12.7	0.500	3.5	3.01
20BG	20	3/4	20-225	3-36	19.0	0.750	7.7	6.62

Repair Kits

Model	Gas Class	Kits AC	Kits DC
6QLS/10QLS	Class 1	KM3088	KM3088
6QLS/10QLS	Class 3	KM2654	KM2654
6QLS2/10QLS2	Class 1	KM2374	KM2374
6QLS2/10QLS2	Class 3	KM3089	KM3089
6QG	-	KM1975	-
10QG	-	KM1975	-
12BAL	-	KM2038	KM2359
20BAL	-	KM2511	KM2512
12QA2	-	KM1905	KM2499
12BA2	-	KM1626	KM1657
20BG	-	KM2157	KM2545

Steam, Plastic and Large Port Valves



Steam Valves - Threaded Port

Model	Function	Port size RC	Orifice size ømm	Max Working Pressure (kPa)	Cv	Media Temp. (°C)	Features
AP11-10A	NC*	3/8	10	1000	1.8	-10~180	Air, Fluid and Steam, 2 way
AP11-15A	NC*	1/2	15	1000	4.5	-10~180	Pilot Piston Type High
AP11-20A	NC*	3/4	20	1000	9.3	-10~180	Pressure, Body: Brass
AP11-25A	NC*	1	25	1000	12.0	-10~180	Forged†, Seals: Teflon
AP11-32A	NC*	1 1/4	32	1000	22.0	-10~180	Operator: Stainless Steel Voltages: 220VAC

* Normally open version note AP12 series

† Stainless body version available. Lead time on application

Note: Only 220VAC 60Hz coils available with flying lead connection

Large General Purpose Valves

Model	Function	Port size RC	Orifice size ømm	Max Working Pressure (kPa)	Cv	Media Temp. (°C)	Features
AP11-50A	NC	2	50	Air = 1200 Water = 1000 Light Oil = 600	48.0	-10 ~ 60	Pilot Operated, Body: Brass Seals: Nitrile, Viton 220VAC/60Hz

This valve is not compatible for steam applications.

Plastic and PTFE Body - Corrosive and General Purpose Valve

Model	Function	Port size G	Orifice size ømm	Pressure (Bar) Air and Fluid AC/DC	Vacuum (Hg") AC/DC	Media Temp. (°C)	Material of Construction	Features
1511	NC	1/8	1.4	0-10/0-10	27	5 - 80	Body - glass reinforced PBT	Direct Acting Valve Air, Fluid and Vacuum
1611	NO	1/8	1.4	0-10/0-10	27	5 - 80	Seals - NBR (std.) Viton Operator - Brass and Stainless Steel	Manual Override Manifolding up to 10 units 25wAC/ 5wDC
3512	NC	1/4	8	0.8-10/0.8-10	-	5 - 80	Body - glass reinforced PBT	Pilot Assisted Valve, Air and Fluid
3513	NC	3/8	10	0.8-10/0.8-10	-	5 - 80	Seals - NBR (std.)	
3514	NC	1/2	12	0.8-10/0.8-10	-	5 - 80	Viton	
3515	NC	3/4	20	0.8-10/0.8-10	-	5 - 80	Operator - Brass and Stainless Steel	2.5wAC/5wDC
3516	NC	1	25	0.8-10/0.8-10	-	5 - 80		
4512	NC	1/4	8	0.8-10/0.8-10	-	5 - 80	Body - glass reinforced PBT	Pilot Assisted Valve Air and Fluid
4513	NC	3/8	10	0.8-10/0.8-10	-	5 - 80	Seals - NBR (std.)	
4514	NC	1/2	12	0.8-10/0.8-10	-	5 - 80	Viton	
4515	NC	3/4	20	0.8-10/0.8-10	-	5 - 80	Operator -	
4516	NC	1	25	0.8-10/0.8-10	-	5 - 80	Stainless Steel	
4517	NC	1 1/4	32	0.8-7/0.8-7	-	5 - 80		
4518	NC	1 1/2	40	0.8-7/0.8-7	-	5 - 80		
4613	NO	3/8	10	0.8-10/0.8-10	-	5 - 80		
4614	NO	1/2	12	0.8-10/0.8-10	-	5 - 80		
4615	NO	3/4	20	0.8-10/0.8-10	-	5 - 80		
4616	NO	1	25	0.8-10/0.8-10	-	5 - 80		

Special Purpose Valves and Timers



Plastic and PTFE Body - Corrosive and General Purpose Valve

Model	Function	Port size G	Orifice size ømm	Pressure (Bar) Air and Fluid AC/DC	Vacuum (Hg") AC/DC	Media Temp. (°C)	Material of Construction	Features
5512	NC	1/4	8	0-10/0-4	27	5 - 80	Body - glass	Coupled
5513	NC	3/8	10	0-10/0-4	27	5 - 80	reinforced PBT	Diaphragm,
5514	NC	1/2	12	0-10/0-4	27	5 - 80	Seals - NBR (std.)	Pilot Assisted
5515	NC	3/4	20	0-10/0-2	27	5 - 80	Viton	Valve, Air, Fluid
5516	NC	1	22	0-10/0-2	27	5 - 80	Operator -	and Vacuum
5612	NO	1/4	8	0-2/0-2	-	5 - 80	Stainless Steel	8wAC/10wDC
5613	NO	3/8	10	0-2/0-2	-	5 - 80		
5614	NO	1/2	12	0-2/0-2	-	5 - 80		
5615	NO	3/4	20	0-1/0-1	-	5 - 80		
5616	NO	1	22	0-1/0-1	-	5 - 80		
8518P	NC	1 1/2	40	1-9/1-9	-	5 - 60	Body - glass	Pilot Assisted
8519P	NC	2	50	1-9/1-9	-	5 - 60	reinforced PBT	Valve, Air
85110P	NC	3	80	1-9/1-9	-	5 - 60	Diaphragm -	and Fluid
85111P	NC	4	100	1-9/1-9	-	5 - 60	Reinforced Natural	Also available
8618P	NO	1 1/2	40	1-9/1-9	-	5 - 60	Rubber	as Pilot
8619P	NO	2	50	1-9/1-9	-	5 - 60	Operator - Brass	Operated
86110P	NO	3	80	1-9/1-9	-	5 - 60	and Stainless Steel	2.5wAC/5wDC
86111P	NO	4	100	1-9/1-9	-	5 - 60		
T95-2-3	NC	1/4	3	0-2/0-2	-	5 - 40	Body - PTFE	Direct Acting
T95-2-6	NC	1/4	6	0-0.5/0-0.5	-	5 - 40	Diaphragm - Teflon	Valve, Acid
T95-3-3	NC	3/8	3	0-5/0-5	-	5 - 40	Coated Viton	and Alkali
T95-3-6	NC	3/8	6	0-1/0-1	-	5 - 40		Corrosive Fluids
T95-4-8	NC	1/2	8	0-1/0-1	-	5 - 40		8-18wAC/
T95-4-12	NC	1/2	12	0-0.5/0-0.5	-	5 - 40		6.5-18wDC

Other voltages on request

Coil Options - for plastic and PTFE valves

Coil Styles	Voltages	
DIN Plug (standard)	415v 50Hz	24v DC
Flying Leads	240v 50Hz	12v DC
Latching Coil	110v 50Hz	
Explosion Proof	24v 50Hz	

Electronic Timers and Adaptor Plugs

Model	Description	Connection	Connection	Features
TEC-22N	Cycle Timer	Square 28m Plug (ISO 4400 Interface)	0.5-10 sec. 'ON' 1-45 min. 'OFF'	External Adjustment Test Override LED 'OFF', LED 'ON' Multi Voltage 24-240V AC/DC
AB-ADAPT	Adaptor Plug	Converts from square 28mm plug to DIN43650B (28 x 22m)		

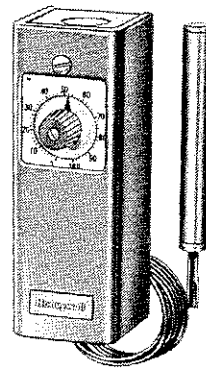
Other time ranges available for TEC-22, customised as required from seconds to hours e.g. 1-60 sec. 'ON' 1-60 sec. 'OFF' 1 amp.

Honeywell

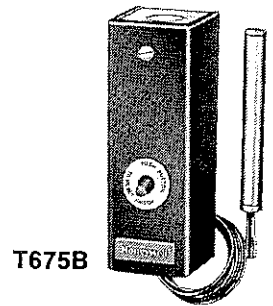
THE T675 AND T678 TEMPERATURE CONTROLLERS REGULATE THE TEMPERATURE OF AIR OR LIQUIDS IN DUCTS, PIPES, TANKS, AND BOILERS. TYPICAL USES INCLUDE CONTROL OF DAMPERS AND VALVES IN HEATING, COOLING, OR HEATING-COOLING SYSTEMS.

- ☐ T675A has 1 single-pole, double-throw (spdt) switch that breaks R-B and makes R-W at the set point on a temperature rise.
- ☐ T675B Manual Reset Low Limit has 1 single-pole, single-throw (spst) switch that breaks at the set point on a temperature fall, and requires manual resetting.
- ☐ T678A has 2 single-pole, double-throw (spdt) switches that operate in sequence. The right switch breaks R-B and makes R-W at the set point on a temperature rise. The left switch breaks R-B and makes R-W if the temperature continues to rise through the interstage differential.
- ☐ T675A models available with an adjustable differential.
- ☐ T675A and T678A have set point adjustment knob on front of case.
- ☐ Capillary tubing allows remote mounting of sensing element; models available with various lengths.
- ☐ T675A and T678A models available with a fast-response sensing element.
- ☐ Controller can be mounted in any position.
- ☐ Mounting accessories available for all applications.
- ☐ Ambient temperature compensated.
- ☐ Insert supplied with TRADELINE models replaces set point knob to discourage tampering.

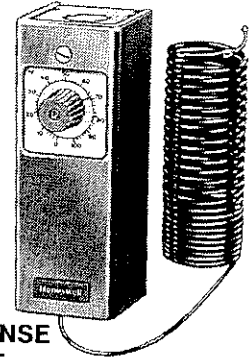
TEMPERATURE CONTROLLERS



T675A,
T678A



T675B



T675A, T678A
WITH FAST-RESPONSE
SENSING ELEMENT

T675A,B; T678A

SPECIFICATIONS

TRADELINE MODELS

TRADELINE models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. TRADELINE model specifications are the same as those of standard models except as noted below.

TRADELINE MODELS AVAILABLE:

T675A and T678A Temperature Controllers—see Table I for TRADELINE models available.

CAPILLARY: 5 ft [1.5 m] long, copper (except 1 T675A model with a 20 ft [6.1 m] capillary).

TRADELINE FEATURES:

- All TRADELINE models include tamper-resist-

ing insert and 107324A Capillary Holder. (Models with fast-response sensing element include 131524A Capillary Holder.)

- TRADELINE models of T675A, T678A supplied with impact-resistant Norel covers.
- TRADELINE pack with cross reference and special instruction sheet.

TABLE I—TRADELINE MODELS AVAILABLE

MODEL	DIFFERENTIAL	OPERATING TEMPERATURE RANGE (SCALE RANGE)		MAXIMUM SAFE BULB TEMPERATURE	
		F	C	F	C
T675A (1 spdt switch)	Adjustable 3 F to 10 F [1.7 C to 5.6 C]	0 to 100 ^{a,b}	-18 to + 38	125	52
		160 to 260	71 to 127	280	138
	Adjustable 3.6 F to 12 F [2.0 C to 6.7 C]	55 to 175 ^a	13 to 79	200	93
	Fixed at 1 F [0.6 C]	0 to 100	-18 to + 38	125	52
T678A (2 spdt switches)	Each switch: Fixed at 3 F [1.7 C] Interstage: Adj. 3 F to 10 F [1.7 C to 5.6 C]	0 to 100 ^a	-18 to + 38	125	52
	Each switch: Fixed at 3.6 F [2.0 C] Interstage: Adj. 3.6 F to 12 F [2.0 C to 6.7 C]	55 to 175 ^a	13 to 79	200	93

^aTRADELINE model also available with a fast-response sensing element, including a 131524A Capillary Holder.

^bTRADELINE model also available with a 20 ft [6.1 m] copper capillary.

continued on page 3

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

1. Order number; specify TRADELINE model, if desired.
2. Operating temperature range (scale range).
3. Standard sensing bulb or fast-response sensing element (if available).
4. Capillary length and material.
5. Fixed or adjustable differential on a T675A.
6. Differential range on adjustable T675A and T678A models.
7. Replacement parts, if desired.
8. Accessories, if desired.

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. YOUR LOCAL HONEYWELL BUILDING CONTROLS SALES OFFICE (CHECK WHITE PAGES OF YOUR PHONE DIRECTORY).
2. BUILDING CONTROLS DIVISION CUSTOMER SERVICE
HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
MINNEAPOLIS, MINNESOTA 55422 (612)542-7500
(IN CANADA—HONEYWELL LIMITED/HONEYWELL LIMITEE, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9) INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

STANDARD MODELS

MODELS (also refer to Table II):

T675A Temperature Controller—spdt switching to make or break a circuit on a temperature change; fast-response models operate approximately 4 times faster than standard models.

T675B Low Limit Temperature Controller—spst

switching to break a circuit on a temperature fall; must be manually reset.

T678A Temperature Controller—2 spdt switches operate 2 independent circuits in sequence; fast-response models operate approximately 4 times faster than standard models.

TABLE II—STANDARD MODELS AVAILABLE.

MODEL	SNAP-ACTING SWITCHES	DIFFERENTIAL ^a	OPERATING TEMPERATURE RANGE (SCALE RANGE) ^c		MAXIMUM SAFE BULB TEMPERATURE	
			F	C	F	C
T675A	1 spdt	Adjustable 3 F to 10 F [1.7 to 5.6 C]	0 to 100	-18 to + 38	125	52
			160 to 260	71 to 127	280	138
		Adjustable 3.6 F to 12 F [2.0 to 6.7 C]	55 to 175	13 to 79	200	93
			0 to 100	-18 to + 38	125	52
		Fixed at 1 F [0.6 C]	55 to 175 ^d	13 to 79	200	93
			160 to 260	71 to 127	280	138
T675B	1 spst	Manual reset ^b	30 to 50 ^e	- 1 to + 10	125	52
T678A	2 spdt	Each switch: Fixed at 3 F [1.7 C] Interstage: Adjustable 3 F to 10 F [1.7 C to 5.6 C]	0 to 100	-18 to + 38	125	52
			160 to 260	71 to 127	280	138
		Each switch: Fixed at 3.6 F [2.0 C] Interstage: Adjustable 3.6 F to 12 F [2.0 C to 6.7 C]	0 to 100 ^f	-18 to + 38	125	52
			55 to 175	13 to 79	200	93

^aAll differentials are subtractive except for the T675B (which has manual reset) and the interstage differential on T678A models.

^bTemperature should rise 10 F [5.6 C] above the set point before resetting.

^cCelsius scaleplates available. See Accessories.

^dModel available with a fast-response sensing element, including a 131524A Capillary Holder.

^eFactory-set and locked at 37 F [3 C].

^fSensing element is a 12 ft [3.7 m] averaging element on the end of a 10 ft [3.0 m] copper capillary.

ELECTRICAL RATINGS:

T675A models with adjustable differential and T678A:

	120 Vac	240 Vac	277 Vac
Full Load	8.0	5.1	4.2
Locked Rotor	48.0	30.6	25.2
Pilot Duty	125 VA	125 VA	125 VA

T675A models with fixed differential—125 VA at 120/208/240/277 Vac.

T675B—125 VA pilot duty up to 277 Vac.

T678A—maximum connected load = 2000 VA.

OPERATING TEMPERATURE RANGE (SCALE RANGE):
See Table II.

DIFFERENTIAL: See Table II.

ADJUSTMENTS:

Set Point (Operating Temperature):

T675A and T678A—adjustment knob on dial on front of controller.

T675B—screwdriver slot in center of dial (cover must be removed).

Differential (cover must be removed):

T675A models with adjustable differential—adjustment dial on snap-acting switch.

T678A interstage differential—star wheel on left side of chassis.

MAXIMUM SAFE BULB TEMPERATURE: See Table II.

TEMPERATURE SENSING ELEMENT: Standard element is a liquid-filled, remote bulb. Some models are available with a fast-response, liquid-filled, coiled capillary element which reduces response time to approximately 1/4 that of the standard bulb.

SENSING BULB SIZE:

Length—4-3/16 in. [106.4 mm].

Diameter—1/2 in. [12.7 mm].

MAXIMUM SENSING BULB PRESSURE: 50 psi [344.7 kPa] for direct immersion.

CAPILLARY LENGTH AND MATERIAL:

T675A and T678A standard models—5 ft [1.5 m] copper, or 20 ft [6.1 m] copper, monel, or stainless steel.

T675A and T678A fast-response models—5 ft [1.5 m] copper capillary with a coiled sensing element on the end; sensing element is coiled 1/8 in. [3.2 mm] tubing, 1-1/2 in. [38.1 mm] diameter x 5 in. [127 mm] long. The coil may be stretched to approximately 10 in. [254 mm].

T675B—10 ft [3.0 m] copper.

CAPILLARY HOLDER: 107324A included with TRADELINE models (except fast-response models). 131524A included with all fast-response models.

WIRING KNOCKOUTS: Two, 7/8 in. [22.2 mm] diameter knockouts for 1/2 in. conduit (1 in the top and 1 in the bottom).

CONTROLLER MOUNTING: Any position; 3 screws through slotted holes in back of case (Fig. 1).

SENSING BULB MOUNTING:

In air ducts—capillary holder (Figs. 2 and 3).

In boilers or storage tanks—immersion well (Fig. 4) or capillary compression fitting (Fig. 5).

DIMENSIONS: See Fig. 1.

APPROVALS:

UNDERWRITERS LABORATORIES INC. LISTED:

T675A and T678A—File No. E4436, Vol. 4; Guide No. XAPX.

T675B—File No. SA481, Vol. 3; Guide No. SDFY.

CANADIAN STANDARDS ASSOCIATION CERTIFIED (120 V, 240 V, and some 208 V models only): T675A and T678A—File No. LR1620, Guide No. 400-E-0.

REPLACEMENT PART:

1. 131524A Capillary Holder, for mounting a fast-response sensing element in an air duct.

ACCESSORIES:

1. 107324A Capillary Holder—for mounting a sensing bulb in an air duct; 8-3/8 in. [212.7 mm] long.

2. 311266D Duct Bulb Holder.

3. Immersion Well Assembly—to protect sensing bulb from mechanical or chemical damage when mounting in a boiler or storage tank; copper, 4-3/4 in. [120.7 mm] insertion length; includes 112721 Tube Clip for clamping capillary tube to immersion well—

—112622AA, 1/2-14 NPT external threads on spud.

—112630A, 3/4-14 NPT external threads on spud.

4. Capillary Compression Fitting—to provide seal-off when mounting sensing bulb directly in a boiler or storage tank; brass, 5/8 in. [15.9 mm] thread length—

—104484A, 1/2-14 NPT external threads on spud.

—104484B, 3/4-14 NPT external threads on spud.

5. 105900 T-strap—for clamping sensing bulb to a pipe or similar mount.

6. 7640HY Bag Assembly—with standoff bracket for mounting the controller to an insulated duct.

7. Q615A Splash-proof Enclosure.

8. 34886A Sun Shield.

9. 801534 Calibration Wrench.

10. 194899 Tamper-resisting Insert Button to conceal set point.

11. Celsius scaleplates for T675.

—194486D: 75 to 125 °C replaces 160 to 260 °F scaleplate.

—194486F: 15 to 75 °C replaces 55 to 175 °F scaleplate.

—194486H: minus 30 to 50 °C replaces 0 to 100 °F scaleplate.

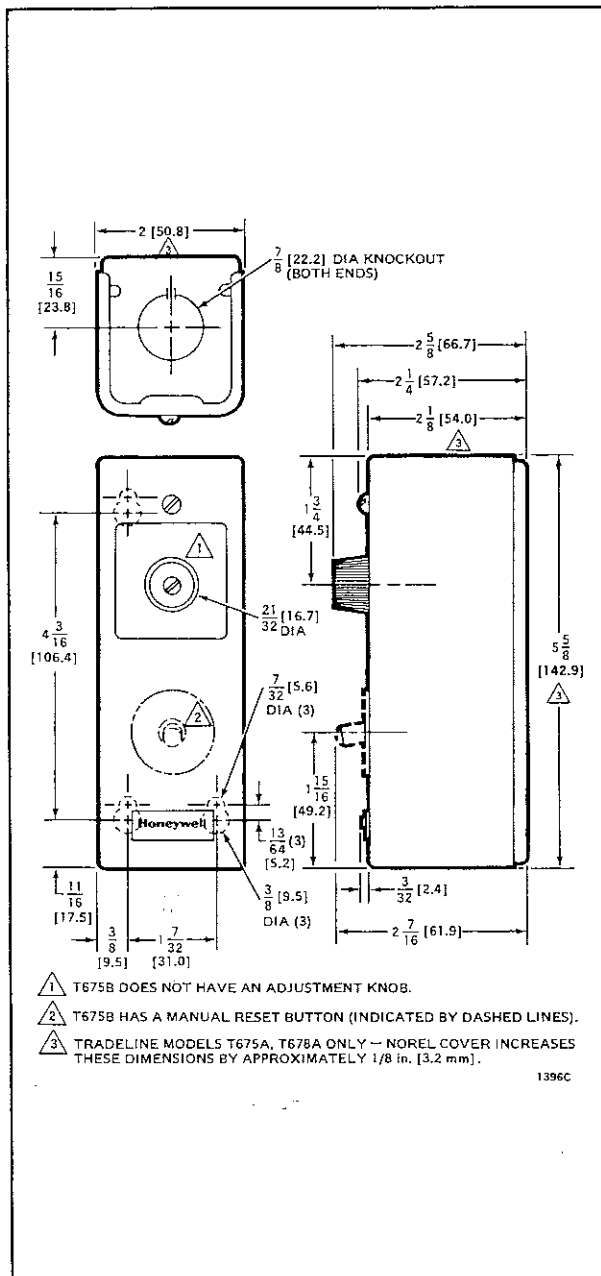


FIG. 1—DIMENSIONS OF THE T675 AND T678 TEMPERATURE CONTROLLER, IN in. [mm IN BRACKETS].

INSTALLATION

WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

CAUTION

Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.

LOCATION AND MOUNTING

The controller may be installed in any convenient position. Mount it with 3 screws through the slotted holes in the back of the case (Fig. 1). Be sure to consider the length of the capillary before mounting the controller.

Install the sensing element where it is exposed to the average temperature of the controlled medium. The sensing bulb may be directly immersed or mounted in a well. T675A or T678A fast-response models must use the capillary holder furnished with the device (Fig. 2). The remote sensing bulb of standard models should be held in place with a capillary holder, immersion well, or compression fitting (Figs. 3-5). Sharp bends or kinks in the capillary tubing affect the efficiency of the controller and must be avoided. Excess capillary should be carefully coiled and left directly beneath the controller.

NOTE: When pressure fittings are used in areas of vibration, such as pipe lines, the bulb must be adequately supported.

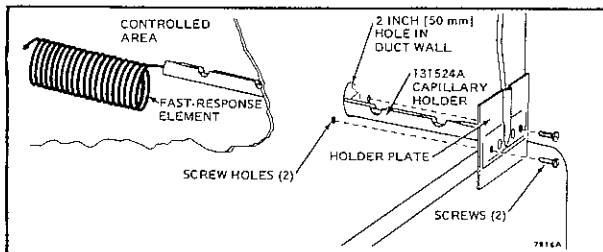


FIG. 2—MOUNTING A FAST-RESPONSE ELEMENT IN AN AIR DUCT.

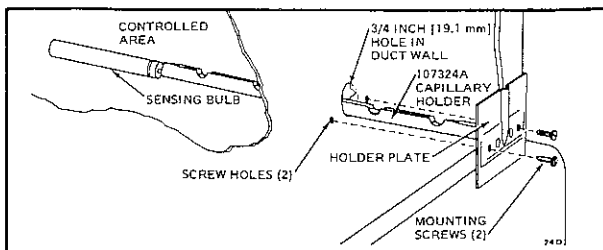


FIG. 3—MOUNTING THE SENSING BULB AND CAPILLARY HOLDER IN AN AIR DUCT.

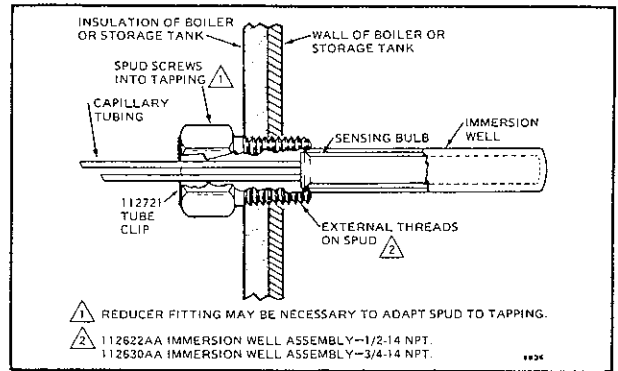


FIG. 4—MOUNTING THE SENSING BULB IN AN IMMERSION WELL.

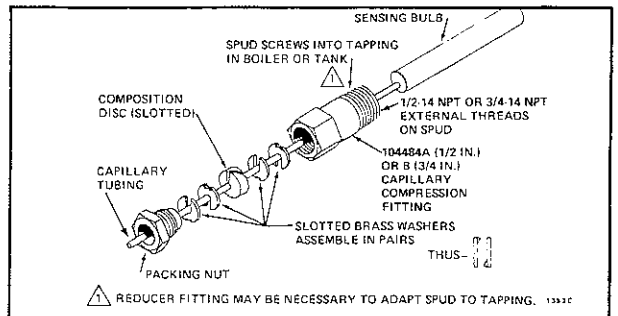


FIG. 5—MOUNTING THE SENSING BULB USING A CAPILLARY COMPRESSION FITTING.

WIRING

Disconnect the power supply before making wiring connections to prevent electrical shock and equipment damage. All wiring must comply with applicable electrical codes, ordinances, and regulations. If using the controller with a flame safeguard control, use moisture-resistant No. 14 wire suitable for at least 167 F [75 C] for a primary control (such as an RA890), or for at least 194 F [90 C] for a programming control (such as an R4140). For high temperature installations, use moisture-resistant No. 14 wire selected for a temperature rating above the maximum operating temperature.

Two knockouts for 1/2 in. conduit are provided—one in the top and one in the bottom of the case. Follow the wiring instructions furnished with the heating or cooling system. Fig. 6 shows the switching action.

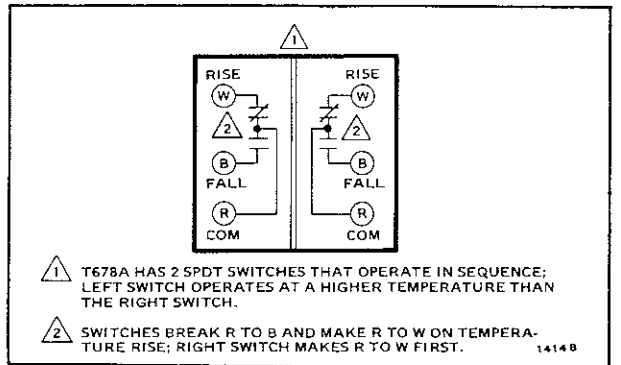


FIG. 6—T678A SWITCHING. T675A HAS ONE spdt SWITCH. T675B HAS ONE spst SWITCH (opens on temp. fall).

OPERATION

T675A

As the temperature of the controlled medium falls below the set point less differential, the T675A switch makes terminals R to B and energizes a normally closed solenoid valve to provide heat. In cooling applications, the T675A makes terminals R to W as the temperature rises above the set point, energizing cooling equipment. Fig. 7 shows the operation of the T675A. Fig. 8 shows the location of the adjustment dial on models with an adjustable differential.

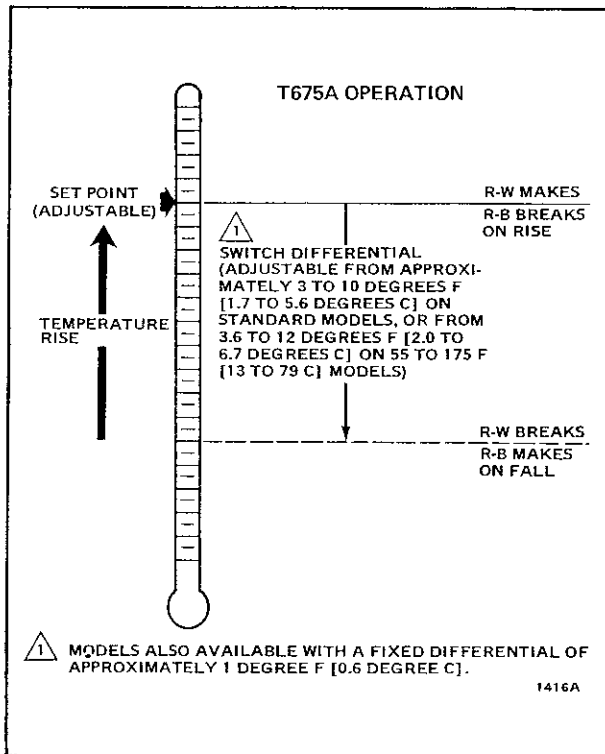


FIG. 7—OPERATION OF THE T675A.

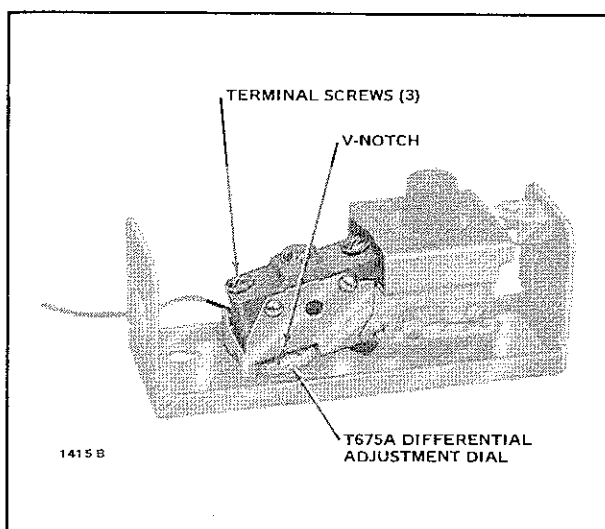


FIG. 8—LOCATION OF THE ADJUSTMENT DIAL ON T675A MODELS WITH AN ADJUSTABLE DIFFERENTIAL.

FREEZE-UP PROTECTION

When using the T675A (auto-recycling) for freeze-up protection, the recommended set point is 38 F [3.3 C] plus the switch differential.

EXAMPLE: Set point of 38 F [3.3 C] plus 1 F [0.6 C] (fixed differential model) equals an actual set point of 39 F [3.9 C].

EXAMPLE: Set point of 38 F [3.3 C] plus 3 F [1.7 C] (adjustable differential model) equals an actual set point of 41 F [5 C].

This provides an adequate safety factor for freeze-up protection.

NOTE: The T675B is a manual reset device specifically designed for freeze-up protection.

T675B

Used as a low limit controller, the T675B interrupts the operation of equipment if the temperature of the controlled medium falls below the set point. The device is reset manually after a rise in temperature of approximately 10 F [5.6 C]; push in the manual reset button on the front of the case. The operation of the T675B is shown graphically in Fig. 9.

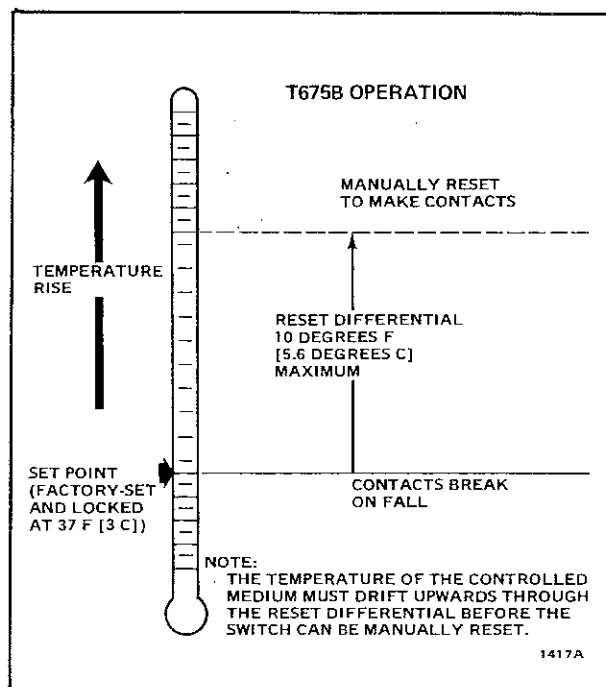


FIG. 9—OPERATION OF THE T675B.

T678A

When the temperature at the sensing element rises above the set point of the controller, the switch on the right makes R-W. Should the temperature continue to rise through the preselected interstage differential of the controller, the switch on the left will make R-W.

Conversely, on a temperature fall, the switch on the left makes R-B, providing first step switching. If the temperature continues to fall, the switch on the right makes R-B to provide sequencing of equipment.

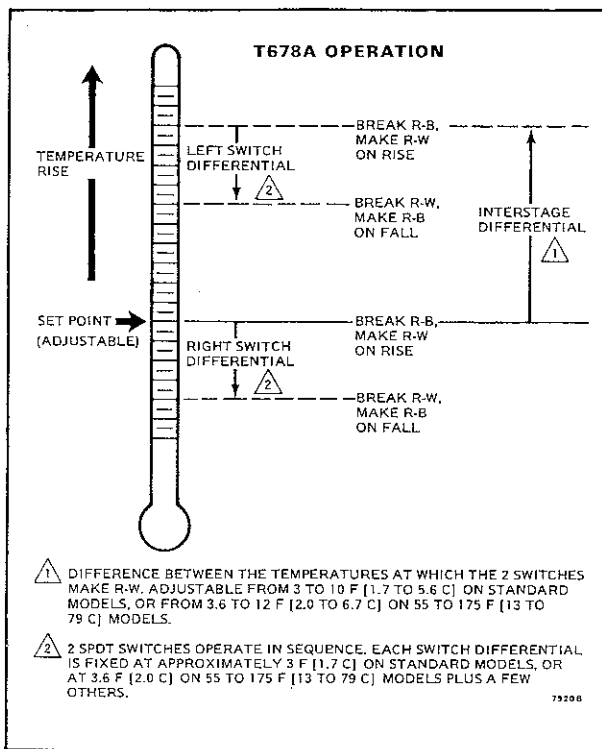


FIG. 10—OPERATION OF THE T678A.

The T678A Temperature Controller has an adjustable interstage differential. The set point adjustment knob determines the temperature at which the right switch operates. The left switch can be adjusted to operate from 3 F to 10 F [1.7 C to 5.6 C] (or 3.6 F to 12 F [2.0 C to 6.7 C] on some models) above the point of operation of the right switch. An illustration depicting the operation of the T678A is shown in Fig. 10. The interstage differential is adjusted by turning the star wheel with a narrow screwdriver inserted into the rectangular hole in the chassis (Fig. 11).

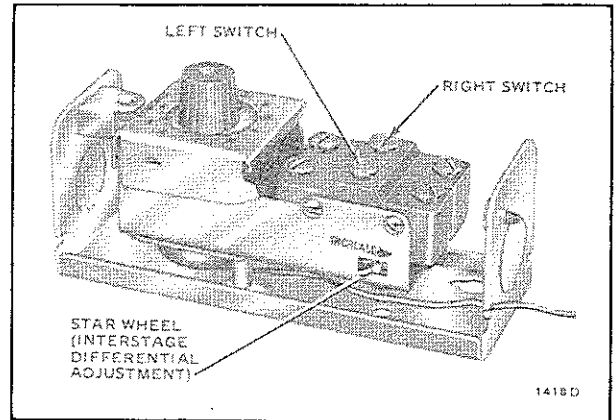


FIG. 11—INTERSTAGE DIFFERENTIAL ADJUSTMENT ON A T678A.

CALIBRATION AND CHECKOUT

All controllers are carefully tested and calibrated at the factory under controlled conditions. If the controller is not operating at a temperature corresponding to the scale setting and differential setting, check to see that the sensing bulb senses the average temperature of the medium controlled. If the temperature of the controlled medium is changing rapidly, the differential will appear wider than its setting.

For calibration, an accurate temperature reading of the controlled medium must be taken. Place an accurate thermometer near the sensing bulb, or refer to a thermometer that has been installed as part of the system. If the sensing bulb is installed in an inaccessible area, or if the controlled medium is unstable, the bulb should be removed and placed in a controlled bath for accurate calibration.

T675A

These controllers are calibrated so that the dial setting, indicated by the pointer on the adjustment knob, is the point at which the R-W switch contacts make on a temperature rise. Measure the temperature at the bulb. Rotate the adjustment knob counterclockwise from the top of the scale, simulating a temperature rise, until the R-W switch contacts make. Note the dial reading. If it differs from the bulb temperature, calibrate the dial as follows:

1. Determine the number of degrees difference between the bulb temperature and the dial reading at which the R-W switch contacts make.
2. Remove the adjustment knob and slip the fingers of the calibration wrench (accessory, Part No. 801534) into the slots of the dial. Rotate the dial until the fingers

of the wrench drop into the slots of the calibration nut under the dial. Note the dial indication at this point. Turn the dial and the calibration nut up or down scale the number of degrees that the bulb temperature differs from the point at which the contacts make (determined in step 1). For example, move the dial from 45 to 65 if the dial reading in step 1 was 45 degrees and the bulb temperature was 65 degrees.

3. Check the calibration adjustment by moving the adjustment knob up and down the scale while listening for the contacts to make and break. If the dial is still out of calibration, repeat the calibration procedure.

T675B

NOTE: The cover must be removed to see the dial. All T675B models have been factory-set and locked at 37 F [3 C].

These controllers are calibrated so that the dial setting, indicated by the fixed pointer at the top of the dial, is the point at which the switch contacts break on temperature fall.

Measure the temperature at the bulb. Remove the cover of the controller. Loosen the locking screw. Insert a screwdriver in the slot in the center of the dial. Start with the dial at the bottom of the scale, and rotate the dial counterclockwise to simulate a temperature fall until the switch contacts break. Note the dial reading. If it differs from the bulb temperature, follow the calibration procedure outlined for the T675A. Tighten the locking screw and replace the cover.

T678A

These controllers are calibrated so that the dial setting, indicated by the pointer on the adjustment knob, is the pointer at which the R-W contacts of the right switch make on a temperature rise. If the temperature continues to rise, the R-W contacts of the left switch make at the dial setting *plus* the interstage differential. (The interstage differential is adjustable as shown in Figs. 10 and 11.)

Measure the temperature at the bulb. Rotate the adjustment knob counterclockwise  from the top of the scale, simulating a temperature rise, until the R-W contacts of the right switch make. Note the dial reading. If it differs from the bulb temperature, follow the calibration procedure outlined for the T675A.

After calibrating the dial, check the setting of the interstage differential. Set the adjustment knob at the

bulb temperature. Then rotate the adjustment knob counterclockwise , simulating a temperature rise, until the R-W contacts of the left switch make. Note the dial reading. The difference between this reading and the bulb temperature is the interstage differential. The interstage differential may be adjusted if necessary (Fig. 11).

CHECKOUT

Check the operation of the controller by raising and lowering the set point through the temperature range of the air or liquid being controlled. Make sure that the controlled equipment operates as intended.

To install tamper-resisting insert on TRADELINE models, remove screw from adjustment knob, remove knob, install insert.



Pneumatic Division North America
Richland, Michigan 49083

Installation and Service
Instructions: 1M102FP

Miniature Series
04R, 05R, & 20R Regulators
04E Filter / Regulator

ISSUED: January, 1999
Supersedes: February, 1994
SCN #P28880

04R, 05R, & 20R Regulators

WARNING

To avoid unpredictable valve behavior that can cause personal injury and property damage:

- Disconnect electrical supply before installation, servicing, or conversion.
- Disconnect air supply and depressurize all air lines connected to this product before installation or conversion.
- Operate within the manufacturer's specified pressure, temperature, voltage and other conditions listed in these instructions.
- Medium should be moisture-free if ambient temperature is below freezing.
- Service according to procedures listed on service instruction sheets.
- Installation, service, and conversion of these products must be performed by knowledgeable personnel who understand how pneumatic valves are to be applied.
- After installation, servicing, or conversion, air and electrical supplies should be connected and the product tested for proper function and leakage. If leakage is present or the product does not function properly, do not put into use.
- Warnings and specifications on the product should not be covered by paint, etc. If masking is not possible, contact your local representative for replacement labels.

Application Limits

These products are intended for use in general purpose compressed air systems only.

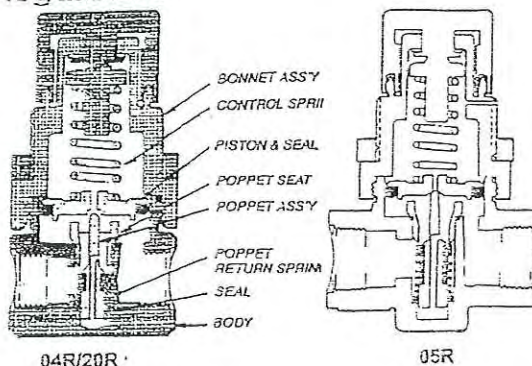
	kPa	PSIG	bar
Operating Pressure Maximum	1700	250	17.0
Operating Temperature Range:	-23°C to 52°C (-10°F to 125°F)		

Installation

1. Install REGULATOR so that fluid flow is in direction of arrow. Installation must be upstream from devices it is to service (lubricator, valve, cylinder, or tool), and mounted closely to the other devices. Mounting may be in any position.
2. Gauge ports are located on both sides of the REGULATOR body for your convenience. It is necessary to install a gauge or socket pipe plugs into each port during installation. (Note: Miniature units use 1/8 NPT, and Economy units use 1/2 NPT).
3. For protection against rust, pipe scale, and other foreign matter, install a FILTER on the upstream (high pressure) sides as close to the REGULATOR as possible.

Operation & Service

1. BEFORE INSTALLING OR DISASSEMBLING REGULATOR FOR SERVICING, SHUT OFF FLUID SUPPLY PRESSURE TO REGULATOR.
2. To service the Regulator, disengage the yellow lock sleeve by pulling upward. Turn adjusting knob counterclockwise until compression is released from the pressure control spring. Remove bonnet assembly to service the piston area, the poppet assembly area, or both.
3. After servicing the Regulator, or upon installing the Regulator, turn on air supply. Then proceed to adjust the desired downstream pressure by turning adjusting knob clockwise. This permits pressure to build up slowly, preventing any unexpected operation of valve, cylinders, tools, etc. in the downstream line.
4. To decrease regulated pressure settings, always reset from a pressure lower than the final setting required. Example, lowering the secondary pressure from 80 PSI to 60 PSI is best accomplished by dropping the secondary pressure to 50 PSI, then adjusting upward to 60 PSI.
5. When desired, secondary pressure settings can be reached by pushing the yellow locking sleeve down to lock the adjusting knob.



Kits Available

Description	Kit No.		
	04R	05R	20R
Bonnet Assembly	L00715		L00715B
Control Springs			
5 to 125 PSI (Air Only)	P78648		P78648
1 to 15 PSI	P78659B		P78659B
2 to 60 PSI	P78660B		P78660B
2 to 110 PSI	P00410B		
1 to 30 PSI	P00411		P00411
Non-Relieving Piston Kit	PS411P		
(1) Piston (Black)			
(1) Piston Seal			
Relieving Piston Kit	PS412BP		
(1) Piston (Black)			
(1) Piston Seal			
Poppet Kit	PS414P	PS416P	PS414P
Gauges			
0 to 60 PSI (0 to 414 kPa)	P530154		P781641
0 to 160 PSI (0 to 1103 kPa)	P77413	P781642	
Panel Mounting Nut	P78652		
Mounting Bracket	PS417BP		

WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application, including consequences of any failure and review the information concerning the product or systems in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

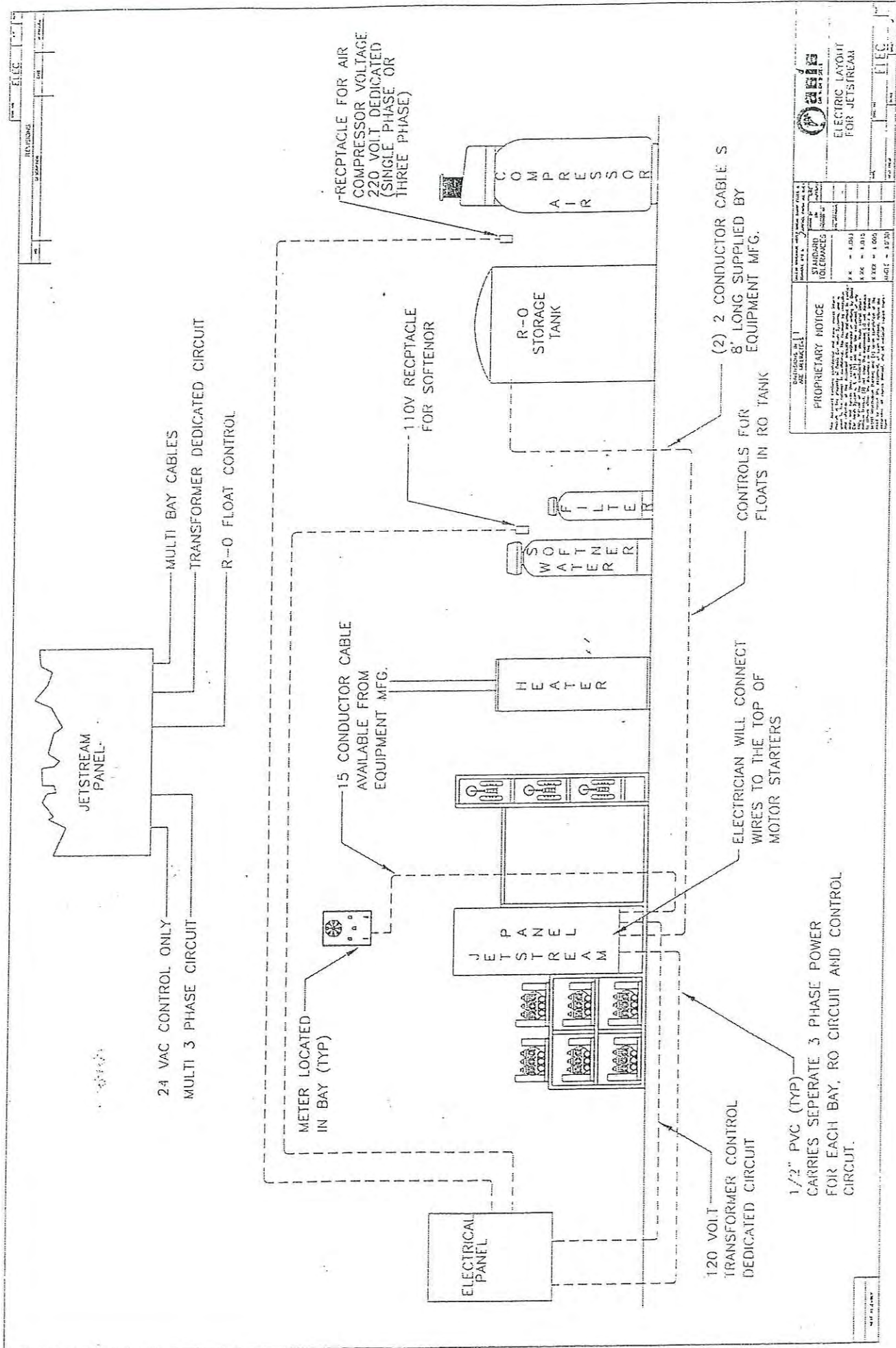
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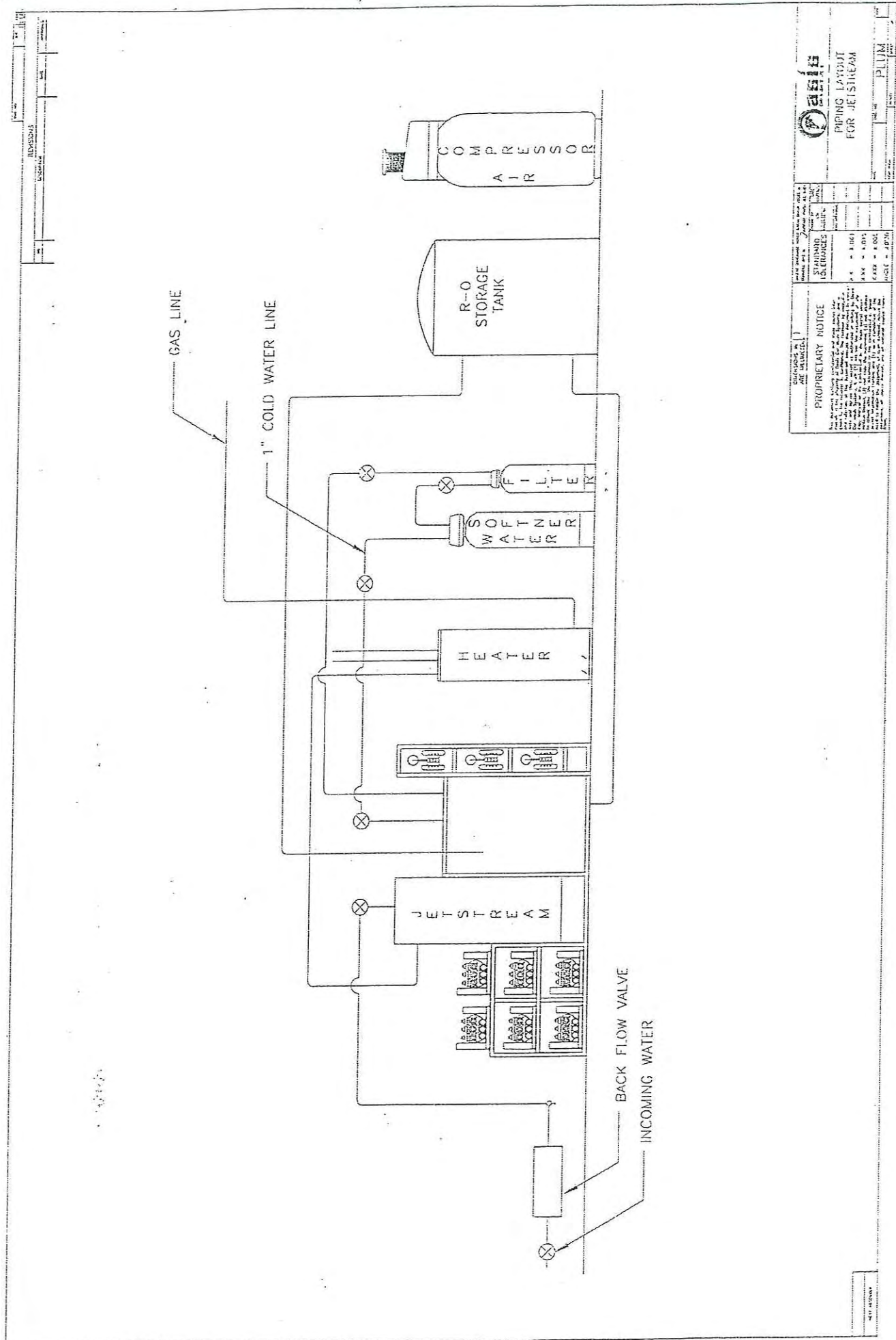
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REVISION	DATE	BY	CHKD
1	10/10/10	J. Smith	M. Jones

PIPING LAYOUT FOR JETSTREAM

PLUM

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide following information:

- Model number
- Serial number (if any)
- Part description and number as shown in parts list

Address parts correspondence to:

Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

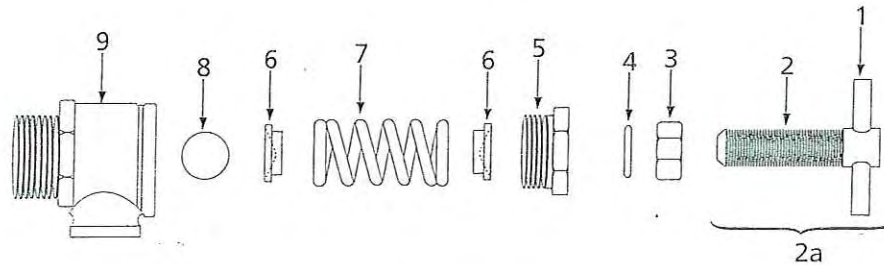


Figure 2 - Replacement Parts Illustrations for Models 4UN28 and 4UN29

Replacement Parts List for Models 4UN28 and 4UN29

Ref. No.	Description	Part Number	Quantity
1	Pin	2040-151-14	1
2	Adjustment Stem	2040-101-01	1
2a	Adjustment Stem Assembly	2040-100-01	1
3	Locknut	2040-005-01	1
4	O-Ring Gasket	2040-005-01	1
5	Cap (4UN28)	2053-003-01	1
5A	Cap (4UN29)	2040-004-01	1
6	Spring Button	2040-003-03	2
7	Spring (4UN28)	2051-051-03	1
7a	Spring (4UN29)	2042-051-03	1
8	Ball	2053-051-03	1
9	Body	2053-001-01	1

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

Please provide following information:

- Model number
- Serial number (if any)
- Part description and number as shown in parts list

Address parts correspondence to:

Grainger Parts Operations
P.O. Box 3074
1657 Shermer Road
Northbrook, IL 60065-3074 U.S.A.

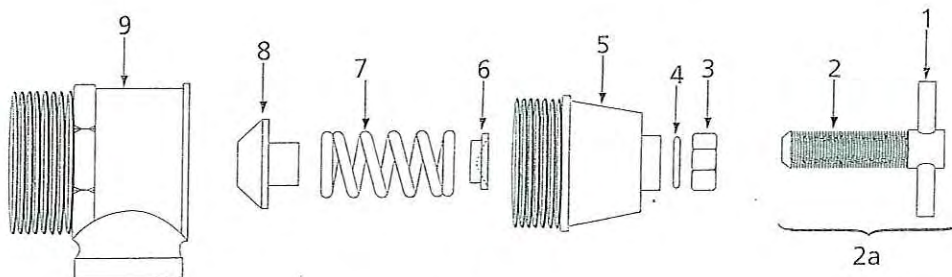


Figure 3 - Replacement Parts Illustrations for Models 4UN31 and 4UN32

Replacement Parts List for Models 4UN31 and 4UN32

Ref. No.	Description	Part Number	Quantity
1	Pin	2040-151-14	1
2	Adjustment Stem	2040-101-01	1
2a	Adjustment Stem Assembly	2040-100-01	1
3	Locknut	2040-005-01	1
4	O-Ring Gasket	2040-053-13	1
5	Cap	2261-003-01	1
6	Spring Button	2040-003-03	1
7	Spring (4UN31)	1100-056-03	1
7a	Spring (4UN32)	2260-051-03	1
8	Seat	2261-002-01	1
9	Body	2261-001-01	1

For Replacement Parts, call 1-800-323-0620

24 hours a day - 365 days a year

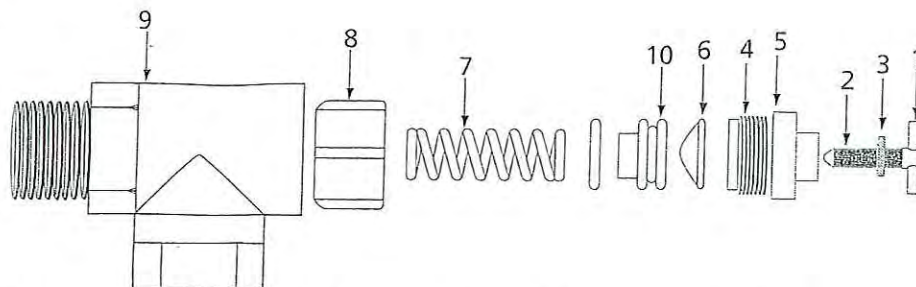


Figure 4 - Replacement Parts Illustrations for Models 4UN30 and 4UN33

Replacement Parts List for Models 4UN30 and 4UN33

Ref. No.	Description	Part Number	Quantity
1	Pin	2066-007-14	1
2	Adjustment Stem	2066-005-01	1
3	Locknut	1700-004-01	1
4	O-Ring Gasket	2066-053-21	1
5	Cap	2066-002-58	1
6	Spring Button	2040-003-03	1
7	Spring (4UN30)	2066-051-03	1
7a	Spring (4UN33)	2066-052-03	1
8	Seat	2066-004-58	1
9	Body	2066-001-58	1
10	Plunger	2066-003-58	1
11	O-Ring	2066-052-21	1

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. Teel® Relief Valves, Accessories covered in this manual, are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use for one year after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at Dayton's option. For limited warranty claim procedures, see PROMPT DISPOSITION below. This limited warranty gives purchasers specific legal rights which vary from jurisdiction to jurisdiction.

LIMITATION OF LIABILITY. To the extent allowable under applicable law, Dayton's liability for consequential and incidental damages is expressly disclaimed. Dayton's liability in all events is limited to and shall not exceed the purchase price paid.

WARRANTY DISCLAIMER. Dayton has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in the "LIMITED WARRANTY" above is made or authorized by Dayton.

PRODUCT SUITABILITY. Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While Dayton attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this limited warranty, any implied warranty of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Teel® Relief Valves

Description

Teel relief valves permit pressure to build up to a preselected point in the spray boom, then bypass liquid back to the supply tank while maintaining the set pressure. They are designed to prevent damage to positive displacement type pumps (piston, gear, roller, etc.) where discharge blockage or shut-off can occur during pumping operation. They maximize sprayer system performance and protection.

Bronze models handle nonflammable liquids that are compatible with a bronze body and seat, and a stainless steel spring. The maximum temperature of the liquid is 180°F. All models feature a free-floating seat and extra-large valve passage to handle full flow from the supply line. Pressures are adjustable from 0-400 psi. A pressure setting securely locks in place with a locknut. These valves can be operated in any position. Not for hot water heaters, boilers, or steam service.

For users of positive displacement pumps.

Installation

Install on the pressure side of the pump to regulate pressure.

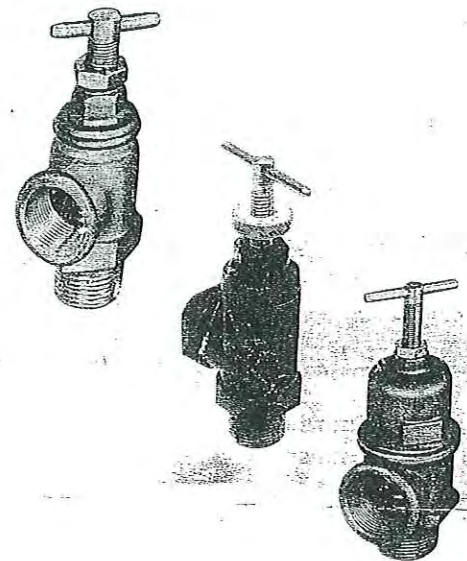
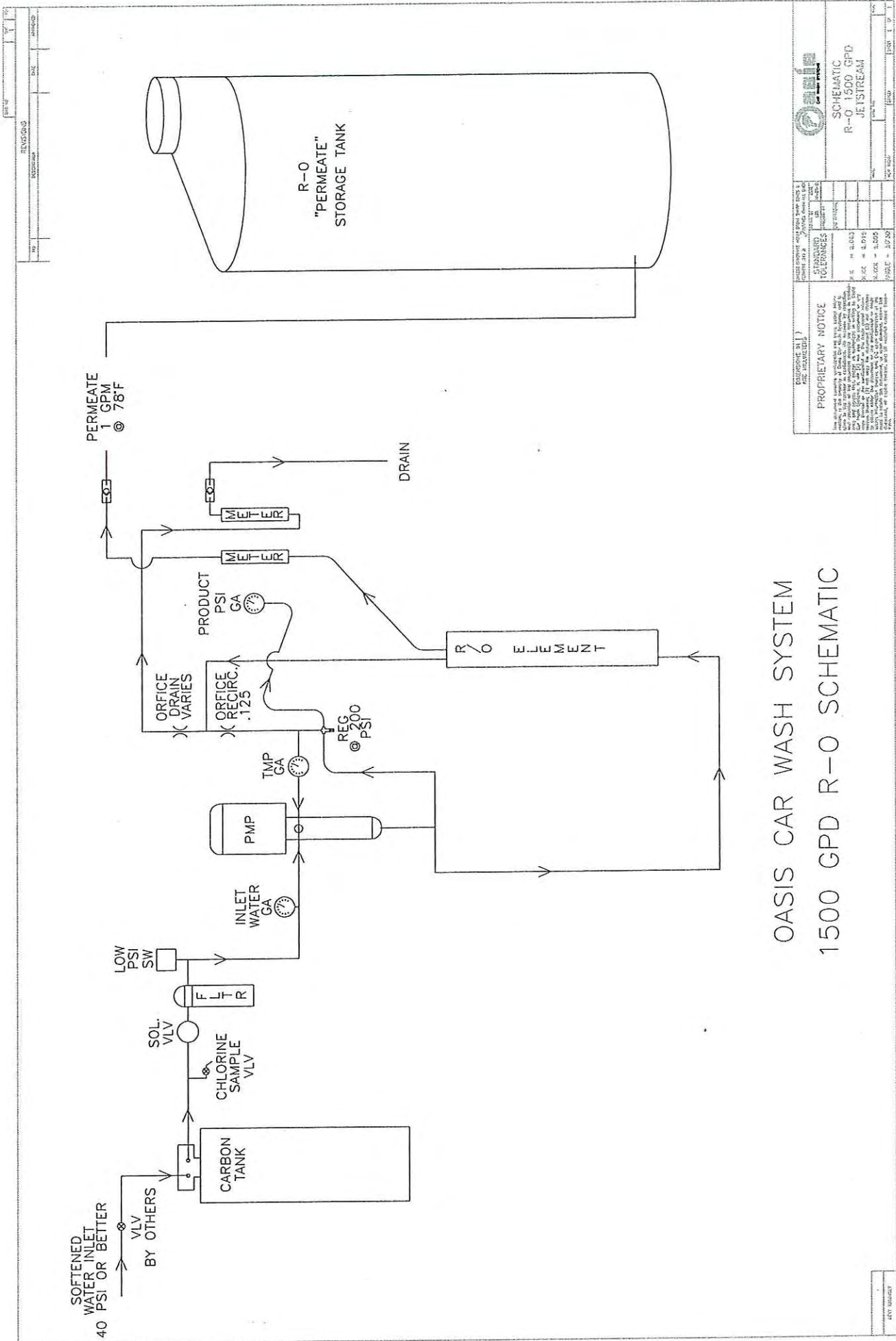


Figure 1 - Relief Valves.

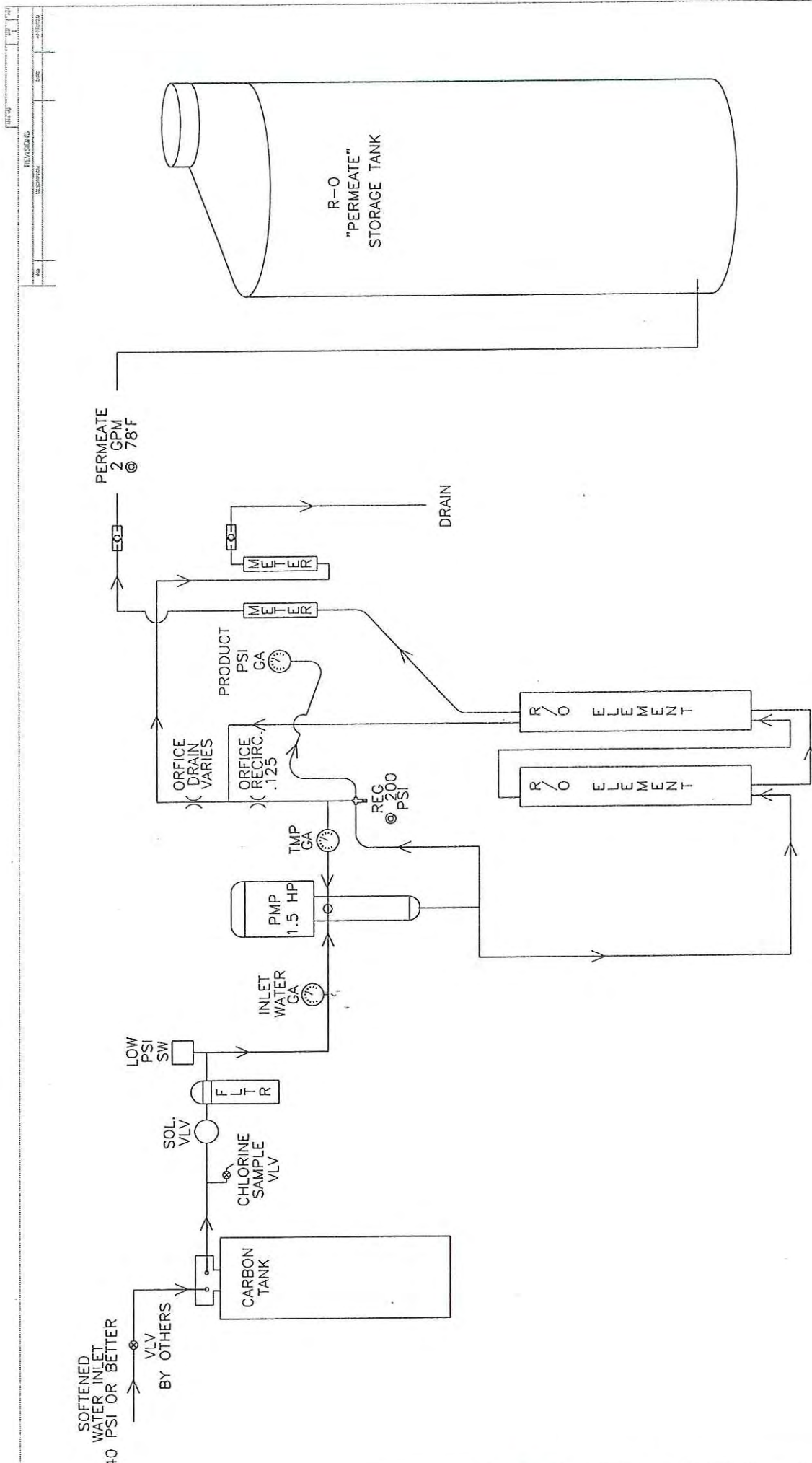
Model Number	Maximum Pressure (psi)	Body Material	Valve Material	Inlet Ports (in)	Ports (in.)	Max. GPM
4UN28	400	bronze	S.S. ball	3/4 MNPT	3/4 FNPT	6
4UN29	200	bronze	S.S. ball	1/2	1/2	6
4UN30	150	nylon	nylon	3/4	3/4	13
4UN31	300	bronze	S.S. ball	3/4	3/4	25
4UN32	150	bronze	bronze	1	3/4	40
4UN33	250	nylon	nylon	3/4	3/4	22



OASIS CAR WASH SYSTEM
1500 GPD R-O SCHEMATIC

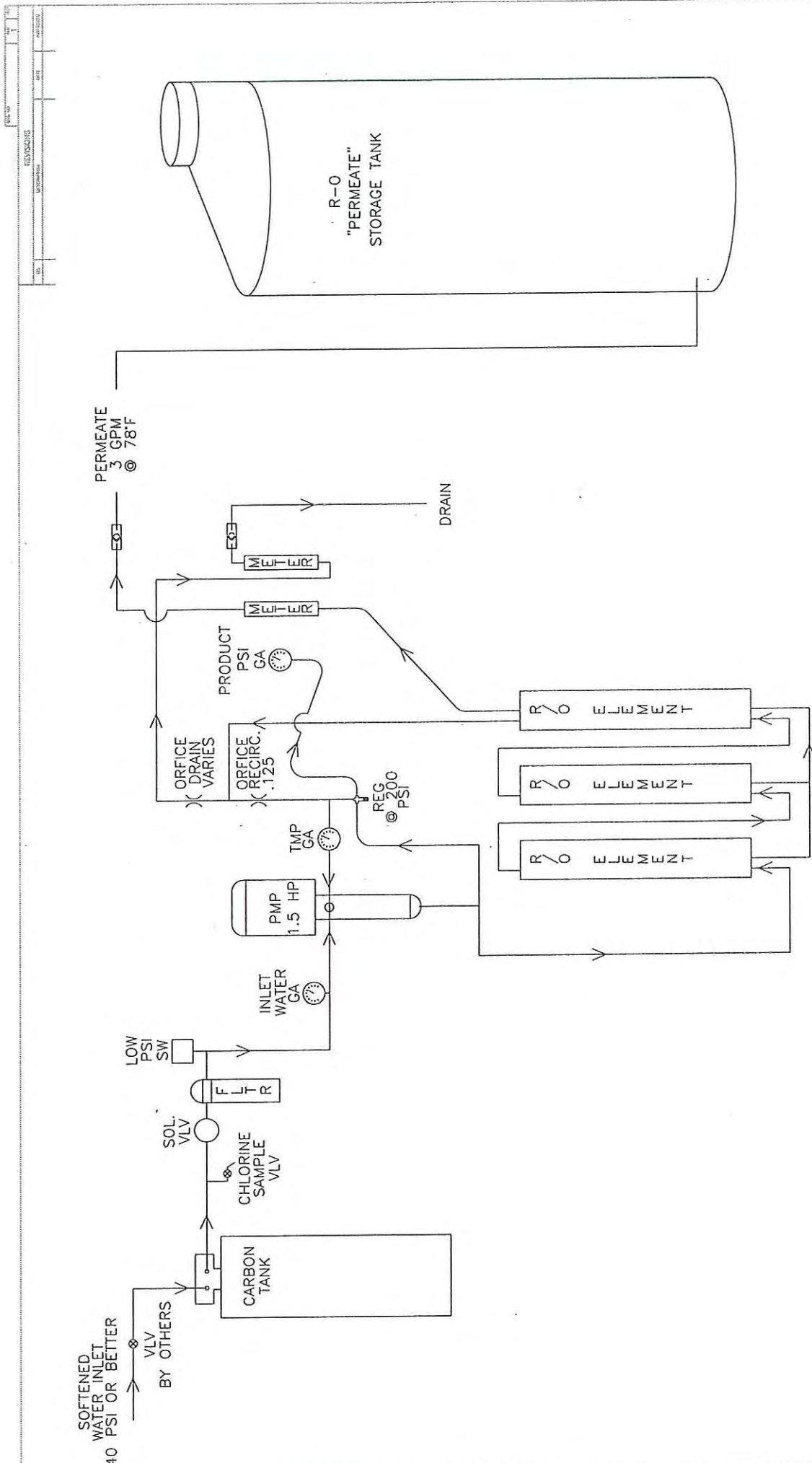
SCHEMATIC R-O 1500 GPD JETSTREAM	
PROJECT NO. DATE DRAWN BY CHECKED BY APPROVED BY	REVISIONS NO. DATE DESCRIPTION 1 11/11/11 1500 GPD JETSTREAM

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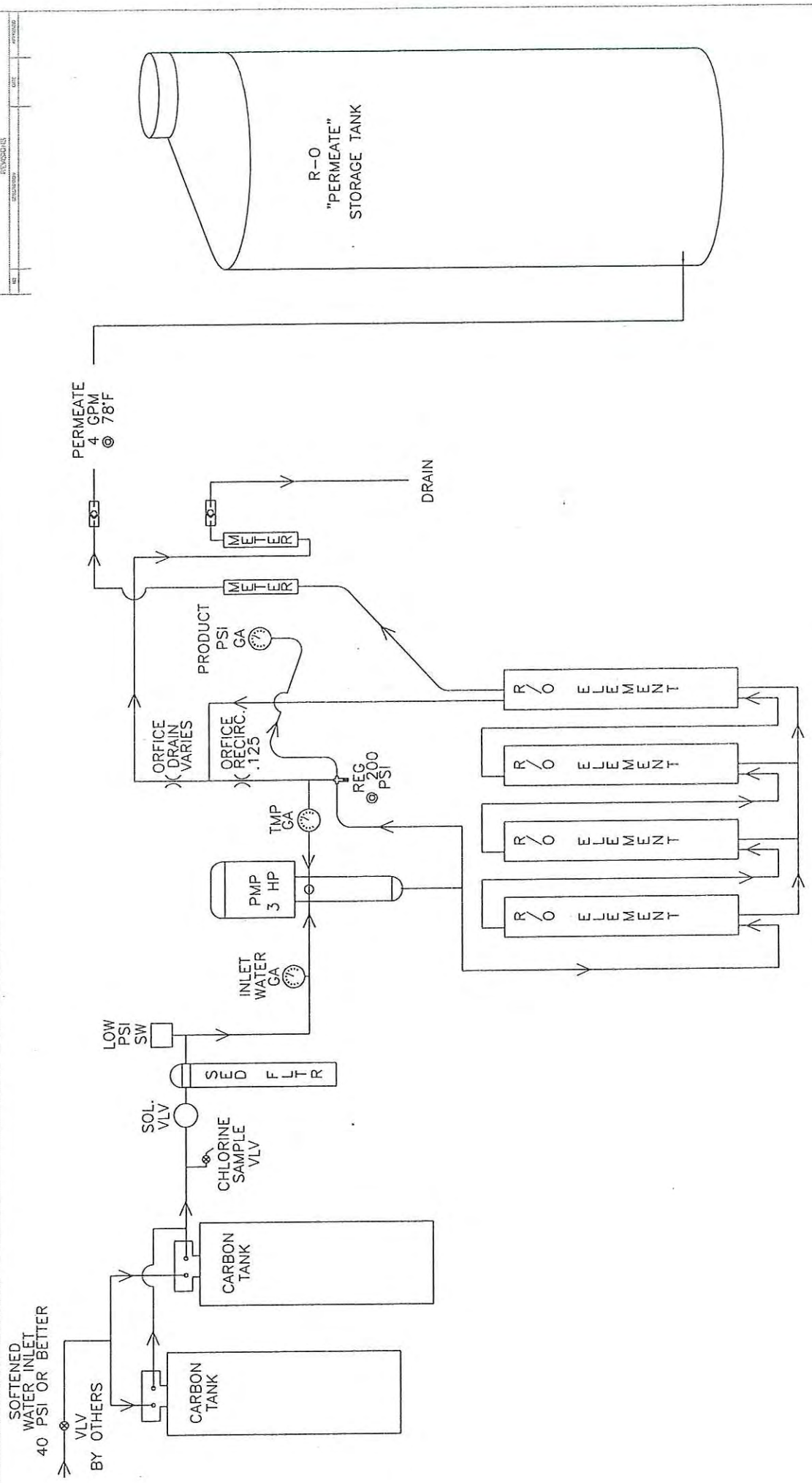
OASIS CAR WASH SYSTEM
3000 GPD R-O SCHEMATIC

		SCHEMATIC R-O 3000 GPD JETSTREAM	
PROPRIETARY NOTICE No document contains information that should be used for the purpose of copying, reproducing, or otherwise disclosing the design or operation of the system without the express written consent of Oasis Car Wash Systems, Inc.	REVISIONS DATE: 10/15/03 BY: J. D. H.	QUANTITIES R-O ELEMENTS: 2 PUMP: 1 REGULATOR: 1 METERS: 2 GAS GAUGES: 4 VALVES: 10 FILTERS: 1 CARBON TANK: 1 CHLORINE SAMPLE VLV: 1 SOL. VLV: 1 LOW PSI SW: 1 F L T R: 1	SCALE 1" = 20'-0"



OASIS CAR WASH SYSTEM
4500 GPD R-O SCHEMATIC

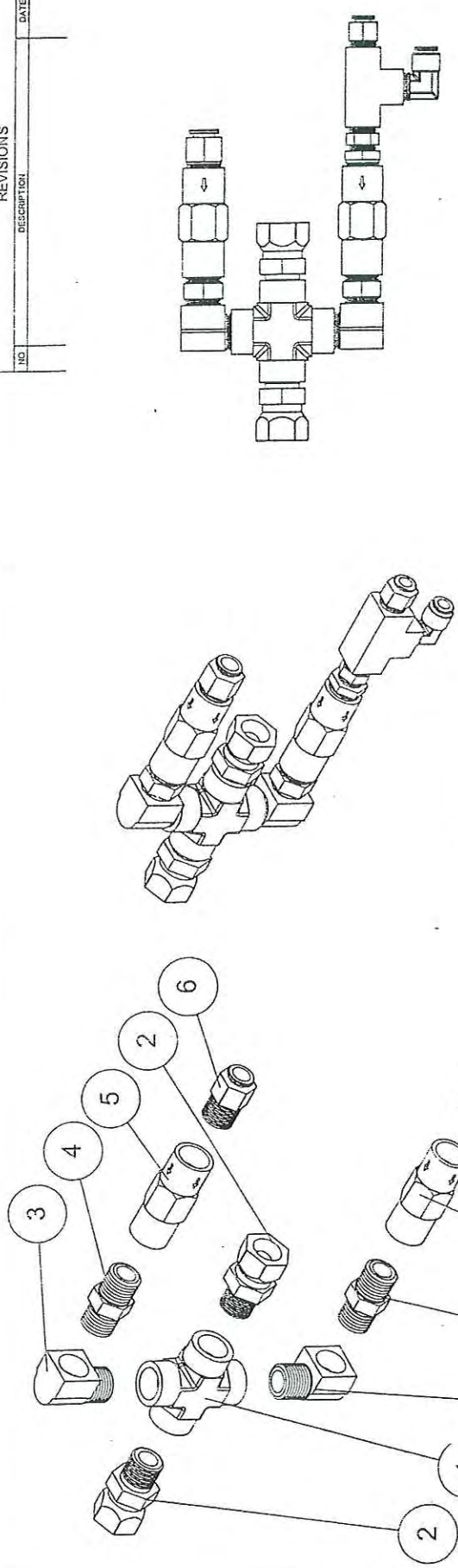
		SCHEMATIC R-O 4500 GPD JETSTREAM	
DRAWING NO. 2-11 DATE 10-1-78 BY J. B. BROWN CHECKED BY J. B. BROWN	STANDARD TOLERANCES FRACTIONS DECIMALS ANGLES HOLE TAP	FINISHES SURFACES MATERIALS DIMENSIONS WEIGHTS VOLUMES TEMPERATURES PRESSURES SPEEDS RATES TIMES PERIODS CYCLES PERCENTS RATIO PROPORTIONS CONVERSIONS UNITS SYMBOLS ABBREVIATIONS REFERENCES NOTES LEGEND EXPLANATIONS COMMENTS REVISIONS APPROVALS SIGNATURES DATES REVISIONS APPROVALS SIGNATURES DATES REVISIONS APPROVALS SIGNATURES DATES	SHEET NO. 1 OF 1 PROJECT NO. 2-11 DRAWING NO. 2-11 DATE 10-1-78 BY J. B. BROWN CHECKED BY J. B. BROWN



OASIS CAR WASH SYSTEM
6000 GPD R-O SCHEMATIC

PROPRIETARY NOTICE		STANDARD TOLERANCES		UNLESS OTHERWISE SPECIFIED:		FRACTIONS DECIMALS		.001" .0005"		.002" .0010"		.003" .0015"		.004" .0020"		.005" .0025"		.006" .0030"		.007" .0035"		.008" .0040"		.009" .0045"		.010" .0050"		.011" .0055"		.012" .0060"		.013" .0065"		.014" .0070"		.015" .0075"		.016" .0080"		.017" .0085"		.018" .0090"		.019" .0095"		.020" .0100"		.021" .0105"		.022" .0110"		.023" .0115"		.024" .0120"		.025" .0125"		.026" .0130"		.027" .0135"		.028" .0140"		.029" .0145"		.030" .0150"		.031" .0155"		.032" .0160"		.033" .0165"		.034" .0170"		.035" .0175"		.036" .0180"		.037" .0185"		.038" .0190"		.039" .0195"		.040" .0200"		.041" .0205"		.042" .0210"		.043" .0215"		.044" .0220"		.045" .0225"		.046" .0230"		.047" .0235"		.048" .0240"		.049" .0245"		.050" .0250"		.051" .0255"		.052" .0260"		.053" .0265"		.054" .0270"		.055" .0275"		.056" .0280"		.057" .0285"		.058" .0290"		.059" .0295"		.060" .0300"		.061" .0305"		.062" .0310"		.063" .0315"		.064" .0320"		.065" .0325"		.066" .0330"		.067" .0335"		.068" .0340"		.069" .0345"		.070" .0350"		.071" .0355"		.072" .0360"		.073" .0365"		.074" .0370"		.075" .0375"		.076" .0380"		.077" .0385"		.078" .0390"		.079" .0395"		.080" .0400"		.081" .0405"		.082" .0410"		.083" .0415"		.084" .0420"		.085" .0425"		.086" .0430"		.087" .0435"		.088" .0440"		.089" .0445"		.090" .0450"		.091" .0455"		.092" .0460"		.093" .0465"		.094" .0470"		.095" .0475"		.096" .0480"		.097" .0485"		.098" .0490"		.099" .0495"		.100" .0500"		.101" .0505"		.102" .0510"		.103" .0515"		.104" .0520"		.105" .0525"		.106" .0530"		.107" .0535"		.108" .0540"		.109" .0545"		.110" .0550"		.111" .0555"		.112" .0560"		.113" .0565"		.114" .0570"		.115" .0575"		.116" .0580"		.117" .0585"		.118" .0590"		.119" .0595"		.120" .0600"		.121" .0605"		.122" .0610"		.123" .0615"		.124" .0620"		.125" .0625"		.126" .0630"		.127" .0635"		.128" .0640"		.129" .0645"		.130" .0650"		.131" .0655"		.132" .0660"		.133" .0665"		.134" .0670"		.135" .0675"		.136" .0680"		.137" .0685"		.138" .0690"		.139" .0695"		.140" .0700"		.141" .0705"		.142" .0710"		.143" .0715"		.144" .0720"		.145" .0725"		.146" .0730"		.147" .0735"		.148" .0740"		.149" .0745"		.150" .0750"		.151" .0755"		.152" .0760"		.153" .0765"		.154" .0770"		.155" .0775"		.156" .0780"		.157" .0785"		.158" .0790"		.159" .0795"		.160" .0800"		.161" .0805"		.162" .0810"		.163" .0815"		.164" .0820"		.165" .0825"		.166" .0830"		.167" .0835"		.168" .0840"		.169" .0845"		.170" .0850"		.171" .0855"		.172" .0860"		.173" .0865"		.174" .0870"		.175" .0875"		.176" .0880"		.177" .0885"		.178" .0890"		.179" .0895"		.180" .0900"		.181" .0905"		.182" .0910"		.183" .0915"		.184" .0920"		.185" .0925"		.186" .0930"		.187" .0935"		.188" .0940"		.189" .0945"		.190" .0950"		.191" .0955"		.192" .0960"		.193" .0965"		.194" .0970"		.195" .0975"		.196" .0980"		.197" .0985"		.198" .0990"		.199" .0995"		.200" .1000"		.201" .1005"		.202" .1010"		.203" .1015"		.204" .1020"		.205" .1025"		.206" .1030"		.207" .1035"		.208" .1040"		.209" .1045"		.210" .1050"		.211" .1055"		.212" .1060"		.213" .1065"		.214" .1070"		.215" .1075"		.216" .1080"		.217" .1085"		.218" .1090"		.219" .1095"		.220" .1100"		.221" .1105"		.222" .1110"		.223" .1115"		.224" .1120"		.225" .1125"		.226" .1130"		.227" .1135"		.228" .1140"		.229" .1145"		.230" .1150"		.231" .1155"		.232" .1160"		.233" .1165"		.234" .1170"		.235" .1175"		.236" .1180"		.237" .1185"		.238" .1190"		.239" .1195"		.240" .1200"		.241" .1205"		.242" .1210"		.243" .1215"		.244" .1220"		.245" .1225"		.246" .1230"		.247" .1235"		.248" .1240"		.249" .1245"		.250" .1250"		.251" .1255"		.252" .1260"		.253" .1265"		.254" .1270"		.255" .1275"		.256" .1280"		.257" .1285"		.258" .1290"		.259" .1295"		.260" .1300"		.261" .1305"		.262" .1310"		.263" .1315"		.264" .1320"		.265" .1325"		.266" .1330"		.267" .1335"		.268" .1340"		.269" .1345"		.270" .1350"		.271" .1355"		.272" .1360"		.273" .1365"		.274" .1370"		.275" .1375"		.276" .1380"		.277" .1385"		.278" .1390"		.279" .1395"		.280" .1400"		.281" .1405"		.282" .1410"		.283" .1415"		.284" .1420"		.285" .1425"		.286" .1430"		.287" .1435"		.288" .1440"		.289" .1445"		.290" .1450"		.291" .1455"		.292" .1460"		.293" .1465"		.294" .1470"		.295" .1475"		.296" .1480"		.297" .1485"		.298" .1490"		.299" .1495"		.300" .1500"		.301" .1505"		.302" .1510"		.303" .1515"		.304" .1520"		.305" .1525"		.306" .1530"		.307" .1535"		.308" .1540"		.309" .1545"		.310" .1550"		.311" .1555"		.312" .1560"		.313" .1565"		.314" .1570"		.315" .1575"		.316" .1580"		.317" .1585"		.318" .1590"		.319" .1595"		.320" .1600"		.321" .1605"		.322" .1610"		.323" .1615"		.324" .1620"		.325" .1625"		.326" .1630"		.327" .1635"		.328" .1640"		.329" .1645"		.330" .1650"		.331" .1655"		.332" .1660"		.333" .1665"		.334" .1670"		.335" .1675"		.336" .1680"		.337" .1685"		.338" .1690"		.339" .1695"		.340" .1700"		.341" .1705"		.342" .1710"		.343" .1715"		.344" .1720"		.345" .1725"		.346" .1730"		.347" .1735"		.348" .1740"		.349" .1745"		.350" .1750"		.351" .1755"		.352" .1760"		.353" .1765"		.354" .1770"		.355" .1775"		.356" .1780"		.357" .1785"		.358" .1790"		.359" .1795"		.360" .1800"		.361" .1805"		.362" .1810"		.363" .1815"		.364" .1820"		.365" .1825"		.366" .1830"		.367" .1835"		.368" .1840"		.369" .1845"		.370" .1850"		.371" .1855"		.372" .1860"		.373" .1865"		.374" .1870"		.375" .1875"		.376" .1880"		.377" .1885"		.378" .1890"		.379" .1895"		.380" .1900"		.381" .1905"		.382" .1910"		.383" .1915"		.384" .1920"		.385" .1925"		.386" .1930"		.387" .1935"		.388" .1940"		.389" .1945"		.390" .1950"		.391" .1955"		.392" .1960"		.393" .1965"		.394" .1970"		.395" .1975"		.396" .1980"		.397" .1985"		.398" .1990"		.399" .1995"		.400" .2000"		.401" .2005"		.402" .2010"		.403" .2015"		.404" .2020"		.405" .2025"		.406" .2030"		.407" .2035"		.408" .2040"		.409" .2045"		.410" .2050"		.411" .2055"		.412" .2060"		.413" .2065"		.414" .2070"		.415" .2075"		.416" .2080"		.417" .2085"		.418" .2090"		.419" .2095"		.420" .2100"		.421" .2105"		.422" .2110"		.423" .2115"		.424" .2120"		.425" .2125"		.426" .2130"		.427" .2135"		.428" .2140"		.429" .2145"		.430" .2150"		.431" .2155"		.432" .2160"		.433" .2165"		.434" .2170"		.435" .2175"		.436" .2180"		.437" .2185"		.438" .2190"		.439" .2195"		.440" .2200"		.441" .2205"		.442" .2210"		.443" .2215"		.444" .2220"		.445" .2225"		.446" .2230"		.447" .2235"		.448" .2240"		.449" .2245"		.450" .2250"		.451" .2255"		.452" .2260"		.453" .2265"		.454" .2270"		.455" .2275"		.456" .2280"		.457" .2285"		.458" .2290"		.459" .2295"		.460" .2300"		.461" .2305"		.462" .2310"		.463" .2315"		.464" .2320"		.465" .2325"		.466" .2330"		.467" .2335"		.468" .2340"		.469" .2345"		.470" .2350"		.471" .2355"		.472" .2360"		.473" .2365"		.474" .2370"		.475" .2375"		.476" .2380"		.477" .2385"		.478" .2390"		.479" .2395"		.480" .2400"		.481" .2405"		.482" .2410"		.483" .2415"		.484" .2420"		.485" .2425"		.486" .2430"		.487" .2435"		.488" .2440"		.489" .2445"		.490" .2450"		.491" .2455"		.492" .2460"		.493" .2465"		.494" .2470"		.495" .2475"		.496" .2480"		.497" .2485"		.498" .2490"		.499" .2495"		.500" .2500"		.501" .2505"		.502" .2510"		.503" .2515"		.504" .2520"		.505" .2525"		.506" .2530"		.507" .2535"		.508" .2540"		.509" .2545"		.510" .2550"		.511" .2555"		.512" .2560"		.513" .2565"		.514" .2570"		.515" .2575"		.516" .2580"		.517" .2585"		.518" .2590"		.519" .2595"		.520" .2600"		.521" .2605"		.522" .2610"		.523" .2615"		.524" .2620"		.525" .2625"		.526" .2630"		.527" .2635"		.528" .2640"		.529" .2645"		.530" .2650"		.531" .2655"		.532" .2660"		.533" .2665"		.534" .2670"		.535" .2675"		.536" .2680"		.537" .2685"		.538" .2690"		.539" .2695"		.540" .2700"		.541" .2705"		.542" .2710"		.543" .2715"		.544" .2720"		.545" .2725"		.546" .2730"		.547" .2735"		.548" .2740"		.549" .2745"		.550" .2750"		.551" .2755"		.552" .2760"		.553" .2765"		.554" .2770"		.555" .2775"		.556" .2780"		.557" .2785"		.558" .2790"		.559" .2795"		.560" .2800"		.561" .2805"		.562" .2810"		.563" .2815"		.564" .2820"		.565" .2825"		.566" .2830"		.567" .2835"		.568" .2840"		.569" .2845"		.570" .2850"		.571" .2855"		.572" .2860"		.573" .2865"		.574" .2870"		.575" .2875"		.576" .2880"		.577" .2885"		.578" .2890"		.579" .2895"		.580" .2900"		.581" .2905"		.582" .2910"		.583" .2915"		.584" .2920"		.585" .2925"		.586" .2930"		.587" .2935"		.588" .2940"		.589" .2945"		.590" .2950"		.591" .2955"		.592" .2960"		.593" .2965"		.594" .2970"		.595" .2975"		.596" .2980"		.597" .2985"		.598" .2990"		.599" .2995"		.600" .3000"		.601" .3005"		.602" .3010"		.603" .3015"		.604" .3020"		.605" .3025"		.606" .3030"		.607" .3035"		.608" .3040"		.609" .3045"		.610" .3050"		.611" .3055"		.612" .3060"		.613" .3065"		.614" .3070"		.615" .3075"		.616" .3080"		.617" .3085"		.618" .3090"		.619" .3095"		.620" .3100"		.621" .3105"		.622" .3110"		.623" .3115"		.624" .3120"		.625" .3125"		.626" .3130"		.627" .3135"		.628" .3140"		.629" .3145"		.630" .3150"		.631" .3155"		.632" .3160"		.633" .3165"		.634" .3170"		.635" .3175"		.636" .3180"		.637" .3185"		.638" .3190"		.639" .3195"		.640" .3200"		.641" .3205"		.642" .3210"		.643" .3215"		.644" .3220"		.645" .3225"		.646" .3230"		.647" .3235"		.648" .3240"		.649" .3245"		.650" .3250"		.651" .3255"		.652" .3260"		.653" .3265"		.654" .3270"		.655" .3275"		.656" .3280"		.657" .3285"		.658" .3290"		.659" .3295"		.660" .3300"		.661" .3305"		.662" .3310"		.663" .3315"		.664" .3320"		.665" .3325"		.666" .3330"		.667" .3335"		.668" .3340"		.669" .3345"		.670" .3350"		.671" .3355"		.672" .3360"		.673" .3365"		.674" .3370"		.675" .3375"		.676" .3380"		.677" .3385"		.678" .3390"		.679" .3395"		.680" .3400"		.681" .3405"		.682" .3410"		.683" .3415"		.684" .3420"		.685" .3425	
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REVISIONS		
NO	DESCRIPTION	DATE



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	A-7777	3/8 STEEL MALE CROSS TEE
2	2	A-1430	3/8" SWIVEL ADAPTER
3	2	A-1010	3/8" NPT BRASS STREET ELBOW
4	2	A-1100	3/8" NPT HEX NIPPLE
5	2	A-2456	VLV CHK SST 3500 PSI 8 GPM .375 CV100-HS
6	1	A-3815	PUSH LOCK ADAPTER - 3/8" MNPT X 3/8" TUBE
7	1	A-1017	3/8" NPT X 1/4" NPT BRASS REDUCER BUSHING
8	1	A-1075	1/4" NPT BRASS TEE
9	1	A-1630	1/4" NPT BRASS HEX NIPPLE
10	1	A-3815	PUSH LOCK ADAPTER - 3/8" MNPT X 3/8" TUBE
11	1	A-3612	PUSH LOCK 90° ADAPTER - 1/4" MNPT X 1/4" TUBE

TASK ORDER #: START DATE: END DATE:		DIMENSIONS IN 1/16 ARE MILLIMETERS		UNLESS OTHERWISE NOTED BREAK ALL SHARP EDGES AND CORNERS 0.15 AND SURFACE FINISH ALL OVER	
QUANTITY: DRAWN: CHECKED: RELEP ENG: INFO ENG: QUAL ENG:		PROPRIETARY NOTICE THIS DOCUMENT CONTAINS CONFIDENTIAL AND TRADE SECRET INFORMATION. IT IS THE PROPERTY OF VANDERBILT UNIVERSITY AND IS NOT TO BE REPRODUCED, COPIED, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, WITHOUT THE WRITTEN PERMISSION OF VANDERBILT UNIVERSITY. ANY UNAUTHORIZED DISCLOSURE OR USE OF THIS INFORMATION MAY BE SUBJECT TO PROSECUTION UNDER FEDERAL AND STATE LAWS. THIS DOCUMENT IS NOT TO BE USED FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY VANDERBILT UNIVERSITY. IT IS THE USER'S RESPONSIBILITY TO OBTAIN NECESSARY PERMISSIONS FROM VANDERBILT UNIVERSITY FOR ANY REPRODUCTION OR USE OF THIS DOCUMENT. VANDERBILT UNIVERSITY ASSUMES NO LIABILITY FOR ANY DAMAGE OR LOSS OF PROFITS, BUSINESS, OR REPUTATION, OR FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN A CONTRACT OR TORT ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OF THIS DOCUMENT.		1500 EAST 12th STREET OAKLAND, CA 94612 TEL: (415) 733-1355 FAX: (415) 733-3735 www.vanderbiltuniversity.com	
APPROVALS: DATE:		STANDARD TOLERANCES XX ± .005 XXX ± .0015 XXXX ± .0005 ANGLES ± .030° FLATNESS ± .004"		COMPONENT HIGH PRESSURE BAY MANIFOLD	
MACHINE: SELF-SERV		MATERIAL: LISTED		MACHINE: SELF-SERV	
SIZE: LISTED		SURFACE TREATMENT: N/A		MACHINE: SELF-SERV	
HEAT TREAT: N/A		SCALE: 1:2		MACHINE: SELF-SERV	
SURFACE TREATMENT: N/A		DATE: 2/20/2001		MACHINE: SELF-SERV	
REV: N/A		DRAWN BY: TCS		MACHINE: SELF-SERV	
OF: 1		SCALE: 1:2		MACHINE: SELF-SERV	

APPLICATION-SPECIFIC FUNCTION: MODIF TIME PROG: (Modifying the parameters of a time programmer)

MODIF
TIME
PROG

This function is used to display and/or modify the parameters of a TIME PROG function using a display function.

The digital type LINK TO TIME PROG input must be connected to the LINK TO MODIF TIME PROG output of the TIME PROG function for which the parameters are to be displayed or modified. This link is used by the compiler to determine to which function TIME PROG function a particular MODIF TIME PROG application-specific function is associated. If this input is connected to a digital output other than a LINK TO MODIF TIME PROG output of a TIME PROG function, or if it is not connected, a compilation error will be reported.

When the digital type EVENT READ input changes from OFF to ON, the information of the event whose number is specified on the INTEGER type EVENT NUMBER input is copied to seven INTEGER type outputs:

- YEAR contains the year (1 to 99) for 2001 to 2099
- MONTH contains the month in the year (1 to 12)
- DAY OF THE MONTH contains the day in the month (1 to 31)
- WEEKS contains the weeks in the month (the format of the number on this output is described in the DISPLAY function help)
- DAYS OF THE WEEK contains the days in the week (the format of the number on this output is described in the DISPLAY function help)
- HOUR contains the hour in the day (0 to 23)
- MINUTE contains the minute in the hour (0 to 59)

Digital type outputs associated with each of the preceding outputs can be used to check the validity of the information present on these outputs:

- If the YEAR VALID output is set to ON, the value present on the YEAR output is valid.
- If the MONTH VALID output is set to ON, the value present on the MONTH output is valid.
- If the DAY OF MONTH VALID output is set to ON, the value present on the DAY OF MONTH output is valid.
- If the WEEKS VALID output is set to ON, the value present on the WEEKS output is valid.
- If the DAYS OF THE WEEK VALID output is set to ON, the value present on the DAYS OF THE WEEK output is valid.

- If the HOUR VALID output is set to ON, the value present on the HOUR output is valid.
- If the MINUTE VALID output is set to ON, the value present on the MINUTE output is valid.

If a validity output is set to OFF, the value of the associated output is not valid and its value is indeterminate.

If the EVENT READ input is set to OFF, the validity outputs: YEAR VALID, MONTH VALID, DAY OF MONTH VALID, WEEKS VALID, DAYS OF THE WEEK VALID, HOUR VALID and MINUTE VALID are all set to OFF and the information present on the YEAR, MONTH, DAY OF MONTH, WEEKS, DAYS OF THE WEEK, HOUR and MINUTE outputs have no significance.

When the READ EVENT input is set to ON, the digital type WRITE EVENT input changing from ON to OFF will save the YEAR, MONTH, DAY OF MONTH, WEEKS, DAYS OF THE WEEK, HOUR and MINUTE values in the event whose number is specified on the EVENT NUMBER input.

Notes:

- Depending on the event displayed and with the READ EVENT input set to ON, not all of the validity outputs can be ON: For example, if the event selected is started every day at a certain time, only the WEEKS, DAYS OF THE WEEK, HOUR VALID and MINUTE VALID outputs will be ON.
- Method for modifying the DAYS OF THE WEEK. At the start, Monday "dash furthest on the left" or "M" (on the LCD display) flashes on a black background. If the "OK" button is pressed, Monday flashes on a white background. It can then be added to ("M" appears) or deleted from ("- " appears) the list of days by pressing the "+" or "-" button. Pressing "OK" a number of times in succession scrolls through the positions of all the days of the week which can be added to or deleted from the list. To confirm modifications made, place the cursor on Sunday and press "OK" :Monday flashes on a black background, which indicates that the modifications have been saved.

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GOYEN CONTROLS CO PTY LTD

NOTICE UL approval is restricted to use within the following conditions

valve models		ambient temperature range	fluids	fluid temperature range	porting designation
general purpose	safety				
1,4,5,6 B6M 1,4,5,6 B6M-V 1,2,4 B6M-NO 1,2,4 B6M-NO-V		10 TO 40°C	water air light oil	-40 TO 82°C	
1,4,5,6 B6M-E 1,2,4 B6M-NO-E		10 TO 40°C	water	40 TO 95°C	
1,2,4 B6M3-NO 1,2,4 B6M3-NO-V 1,2,4 B6M3T-NO 1,2,4 B6M3T-NO-V		10 TO 40°C	water air light oil	-40 TO 32°C	1=CYL 2=EX 3=IN
1,2,4 B6M3-NO-E 1,2,4 B6M3T-NO-E		10 TO 40°C	water	40 TO 95°C	
1,2,4 B6M3-NC 1,2,4 B6M3-NC-V 1,2,4 B6M3T-NC 1,2,4 B6M3T-NC-V		10 TO 40°C	water air light oil	-40 TO 82°C	1=CYL 2=IN 3=EX
1,2,4 B6M3-NC-E 1,2,4 B6M3T-NC-E		10 TO 40°C	water	40 TO 95°C	
	6QG, -T,-F,-L 10QG, -T,-F,-L	10 TO 40°C	natural gas LP gas	-34 TO 82°C	
10,12,20,25BL2		10 TO 40°C	propane, air natural gas fuel gas, water light oil	0 TO 82°C 10 TO 82°C	

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valve models		ambient temperature range	fluids	fluid temperature range	porting designation
general purpose	safety				
6,10,12,20,40BW2 6,10,12,20,25BWJ2 6,10,12,20,25BWJ2-V 25BW3 25BW3-V 1,2,3,4Q3M 1,2,3,4Q3M-V 1,2,3,4Q3M-T 1,2,3,4Q3M-V-T 1,2,3,4Q3M-D 1,2,3,4Q3M-D-V 6,10,12QW2-D 6,10,12QW2-V-D 6,10,12QW2 6,10,12QW2-V 6,10,12QW2-T 6,10,12QW2-V-T 6,10,12QW2-R		10 TO 40°C	air water light oil	-40 TO 82°C	
12QA2		10 TO 40°C	air	-40 TO 82°C	
6,10,12,20,25BWJ2-E 6,10,12,20,40BW2-E 25BW3-E		10 TO 40°C	water	40 TO 95°C	
RCA3D2,RCA3D2-T RCA5D2		10 TO 40°C	air	10 TO 40°C	
	GSV-3	-40 TO 57°C	gasoline	10 TO 40°C	
	GSV-7-T GSV-7-AC-T	-40 TO 57°C	propane natural gas LPG	10 TO 40°C	
	10QLS,10QLS-T	-40 TO 57°C	propane	10 TO 40°C	
1,2,4Q3M3-NO-D 1,2,4Q3M3T-NO-D		10 TO 40°C		-40 TO 82°C	1=CYL 2=EX 3=IN
1,2,4Q3M3-NC-D 1,2,4Q3M3T-NC-D		10 TO 40°C		-40 TO 82°C	1=CYL 2=IN 3=EX